This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

THE UNIVERSITY
OF ILLINOIS
LIBRARY
605
SA
n.s. v. 141 cop. 2

605
SA
Eng'ng

The pages which are misssing were removed because they were advertisements.

605
SA

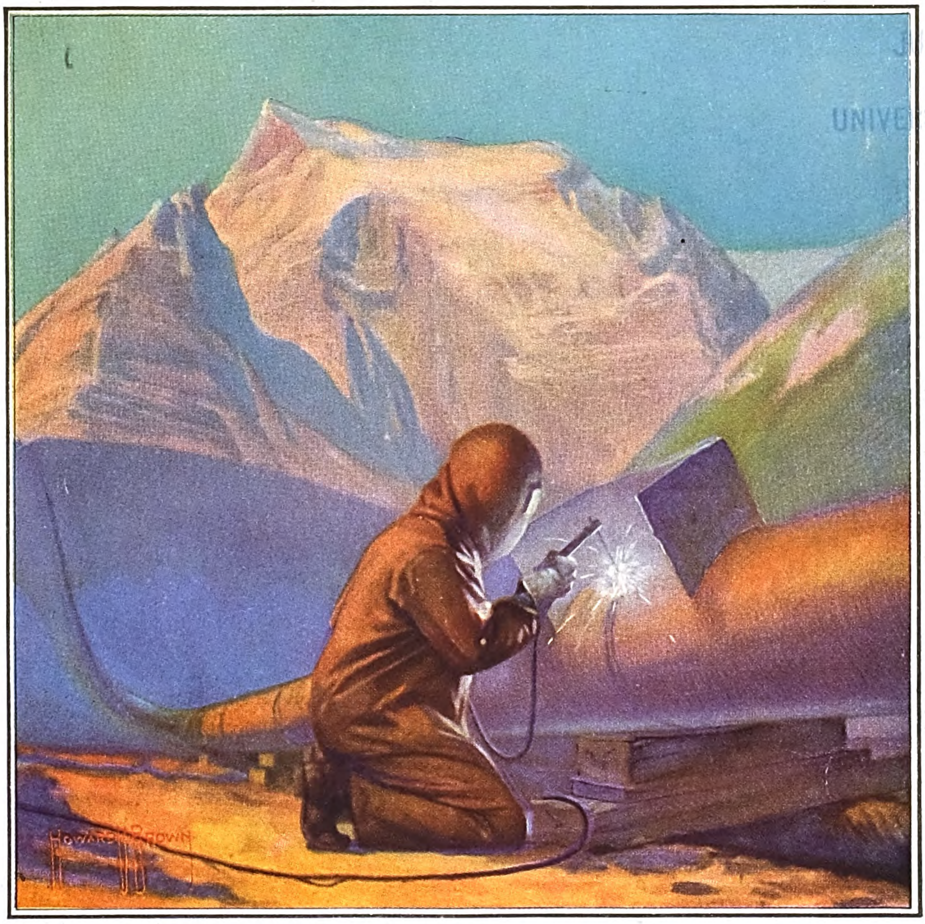
Eng'g

SCIENTIFIC AMERICAN

July 1929

35¢ a Copy

THE LIBRARY OF THE
J N 17 1929
UNIVE SITY OF ILLINOIS



CROSS COUNTRY PIPELINES

LADY HEATH ON FLYING

MANUFACTURED WEATHER

CARS THAT STAY YOUNG

Donald Bender

Cars That Stay Young

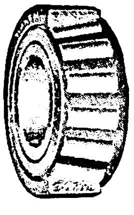
Crosses Indicate "Timken-Equipped" Points

Make	Model	Front Wheels	Rear Wheels	Pinion	Steering	Differential
Auburn	All	.x.	.x.	.x.	...	.x.
Cadillac	All	.x.	.x.	...	.x.	.x.
Chrysler	De Soto	.x.	.x.	.x.	...	.x.
	Plymouth	.x.	.x.	.x.	...	.x.
	65 & 75	.x.	.x.	.x.	...	.x.
	Imperial	.x.	...	...	...	.x.
Cunningham	All	.x.	.x.	.x.	...	.x.
Dodge	All	.x.	.x.	...	...	.x.
Durant	40, 60, 66	.x.	.x.	.x.	...	...
	70	.x.	.x.	.x.	...	.x.
Elcar	75	.x.	.x.	.x.	...	.x.
	95, 96, 120	.x.	.x.	...	...	.x.
Ford	All	.x.	...	.x.	.x.	.x.
Franklin	All	.x.	.x.	.x.	.x.	.x.
Gardner	All	.x	.x.	.x.	...	.x.
Graham-Paige	612	.x.	.x.	.x.	.x.	.x.
	615	.x.	.x.	...	...	.x.
	621, 827, 837	.x.	.x.	...	.x.	.x.
Hudson and Essex	All	.x.	.x.	.x.	...	.x.
Hupmobile	Century 6	.x.	.x.	.x.	.x.	.x.
	Century 8	.x.	.x.	.x.	.x.	.x.
Jordan	All	.x.	.x.	.x.	...	.x.
Kissel	75 & 95	.x.	.x.	.x.	...	.x.
	126	.x.	.x.	.x.	.x.	.x.
Kleiber		.x.	.x.	.x.	...	.x.
LaSalle	All	...	...	...	...	.x.
Lincoln	All	.x.	.x.	.x.	.x.	.x.
Locomobile	86 & 88	.x.	.x.	...	...	.x.
Marmon	68	.x.	...	...	...	.x.
	78	...	.x.	...	...	.x.
	Roosevelt	.x.	.x.	.x.	...	.x.
McFarlan	All	.x.	.x.	.x.	...	.x.
Moon	All	.x.	.x.	.x.	...	.x.
Nash	Std 6	.x.	.x.	.x.	...	.x.
———	All	.x.	...	...	...	.x.
Peerless	All	.x.	.x.	.x.	...	.x.
Pierce-Arrow	All	.x.	.x.	.x.	.x.	.x.
Reo Flying Cloud	The Master	.x.	.x.	...	.x.	.x.
	Flying Cloud	.x.	.x.	...	...	.x.
Roamer		.x.	.x.	.x.	...	.x.
Stearns-Knight	6-80	.x.	.x.	.x	.x.	.x.
	8-90	.x.	.x.	.x.	.x.	.x.
Studebaker and Erskine	All	.x.	x	.x.	.x.	.x.
Stutz	All	.x.	.x.	.x.	...	.x.
Willys-Knight and Whippet	All	.x.	.x.	.x.	.x.	.x.

AWAY on motor-wings, going places, doing things...years of miles go by...what of it?

Youth perennial *abides* in cars Timken-equipped. The threat of thrust, speed, shock and torque is safely entrusted to this age-defying combination—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

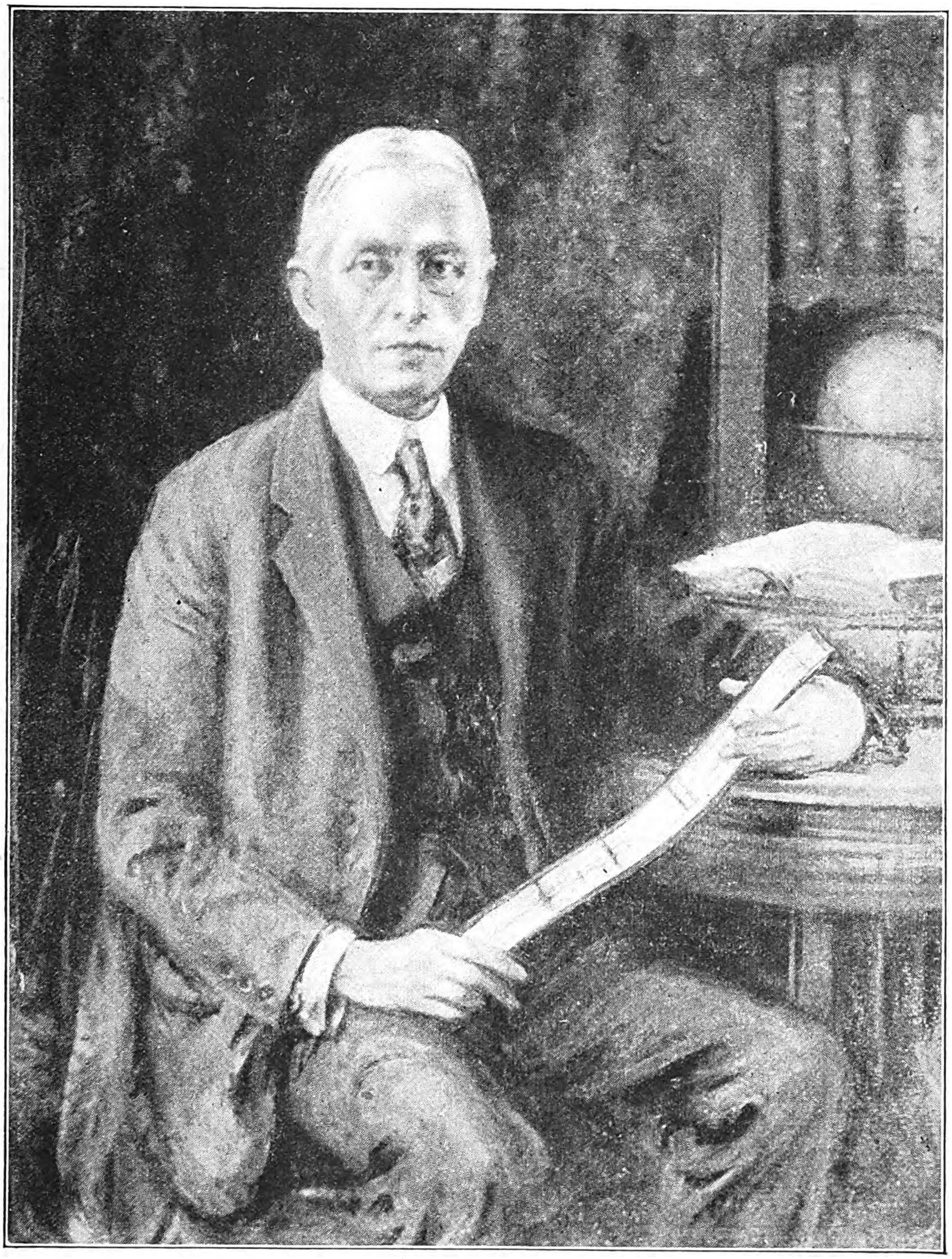
The list on this page tells the story of your car's life and *youth*. Study it well before you buy. Note the points where Timken Bearings are applied and decide for "Cars That Stay Young".



THE TIMKEN ROLLER BEARING COMPANY
CANTON, OHIO

TIMKEN *Tapered Roller*
BEARINGS

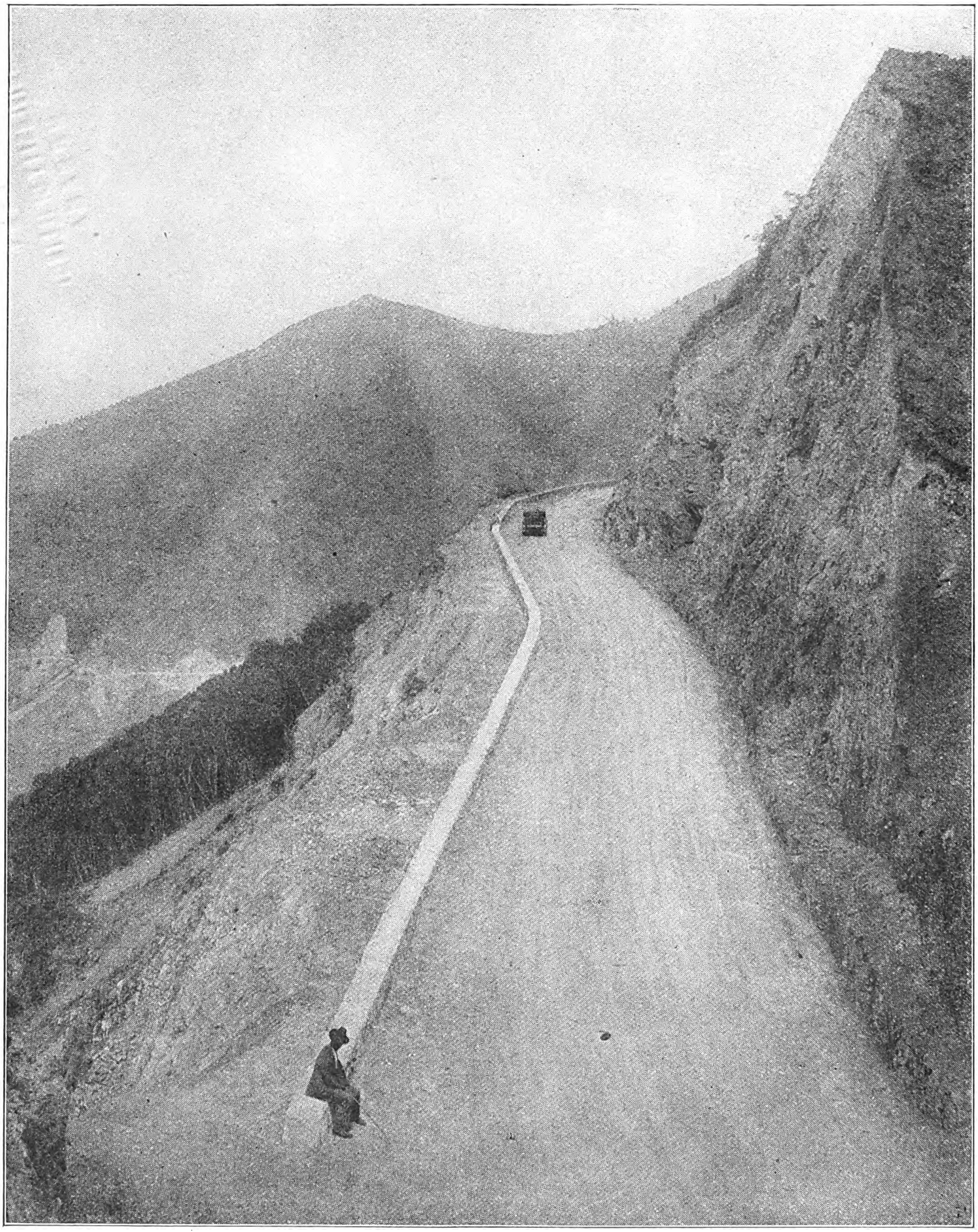
605
SA
n.s. v.141 cop.2 Engineering Library



Henry Norris Russell

THOSE who regularly read in this journal the monthly articles by Professor Henry Norris Russell, on the current advances of astronomy, will be especially interested in the portrait reproduced above. It was painted by Samuel M. Palmer of Philadelphia, and presented to Princeton University by the Class of 1897, on the recent occasion of the endowment by that class of a research professorship of astronomy, the first holder of which will be Dr. Russell. Both artist and subject are also members of that notable graduating class. The reproduction was obtained from Princeton University by the editor. In the portrait Dr. Russell is shown holding a sunspot spectrogram. Dr. Russell's connection with the SCIENTIFIC AMERICAN began about 30 years ago, when he was an obscure graduate student at Princeton. In his first article he struck the vein desired by the editor, and so began a relationship which it is hoped will continue many more years. He is now recognized among scientists, both here and in Europe, as one of perhaps five of the foremost astronomers of the world

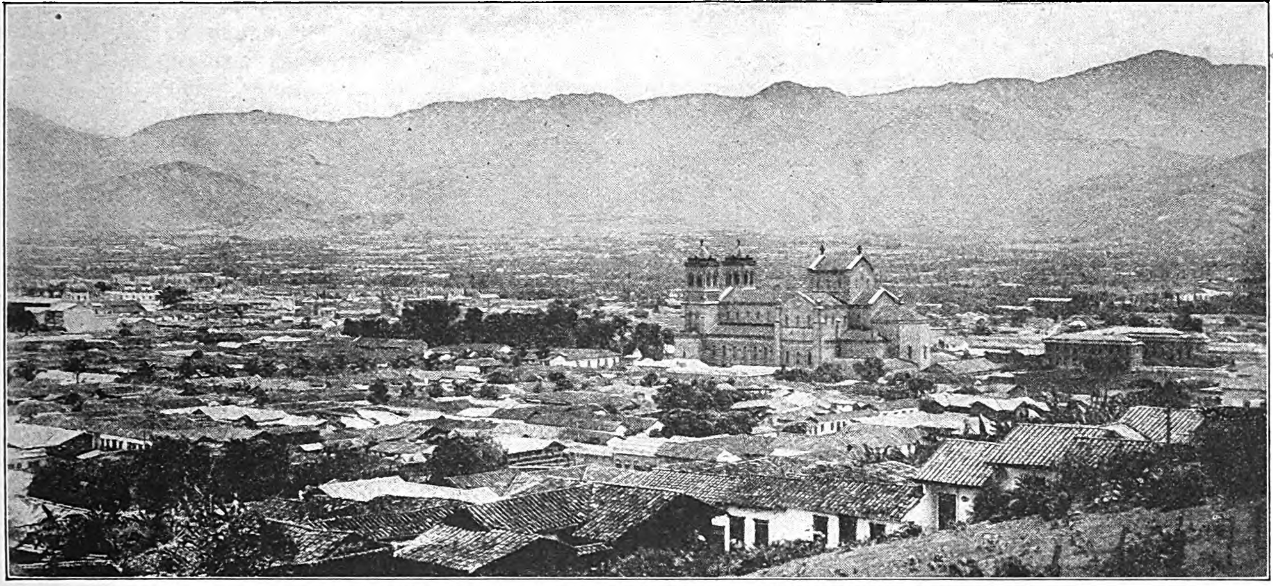
721954



Slashes In the Mountainside

THE path of progress is literally a steep one in the case of the project for building a highway to the sea undertaken by the Department of Antioquia, Colombia. Above is shown a completed section of the road which, when completed, will bring the capital city of this productive department within a few hours' traveling distance of its new seaport. This section was cut through the solid rock of Little Pass, or Boqueroncito, only a short distance from the prosperous capital city, Medellin. The fall to the left of the road is nearly 3000 feet. In the distance to the left is a continuation of the road on a lower level. Up to five tons of dynamite were used in single shots here. See the article on opposite page.

Engineering Library
Engineering Library
605
SA



A PLATEAU CITY FRAGRANT WITH SCENT OF COFFEE BLOSSOMS

A section of the city of Medellin, capital of the Department of Antioquia Colombia, from which the new highway runs northward through Boqueron de San Cristobal, the gap at the left. The city is the center of a mining and agricultural region

Engineering Library

From Colombian Mountains to the Sea

A Rich Hinterland of Colombia, Seeking Independence of its Old Slow Transportation System, Builds a Road to the Sea

By F. D. McHUGH

"TO the sea! To the sea! We want to go to the sea!" The cry went up from a modern city of 100,000 people, a city almost isolated by mountains through which it was impracticable to build a railroad, a city that, for all its progressiveness and importance, still was forced to ship its products and bring in necessities from the outside world by a transportation system that was as costly and uncertain as it was slow.

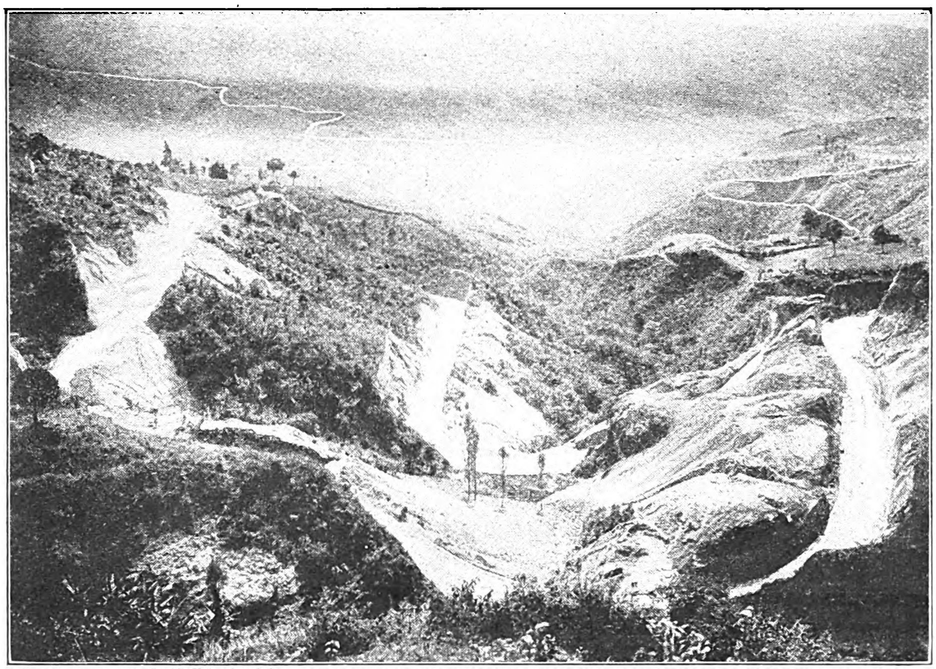
"We want to go to the sea!" One heard it at the clubs where prosperous business men meet, over one's demitasse, in exclusive shops and little shops, on the streets, everywhere; it rose in a crescendo of hope that shadowed lesser ambitions, that transcended political issues. *Carretera al Mar!* The highway to the sea! Posters encouraged it; placards on automobiles urged it; everyone demanded it. *Al Mar* came to be a synonym for patriotism, *Carretera al Mar* a synonym for progress. Thus Medellin, capital city of the Department of Antioquia, Colombia, South America, voiced its determination to build a road to the sea, a road that would mark fulfillment of a long-cherished hope, a road that would give independence of an antiquated transportation system little better than that used by the old Spanish conquistadores. *Carretera al Mar!* The cry resounded through the hills and the echo, answering back, seemed like some age-old cry of anguish, like a battle-cry of the conquistadores themselves, the yearning cry for freedom. The highway to the sea would release Medellin, center of a vast productive district, from the difficulties that had retarded its full development through the centuries.

In an age when almost every major engineering project is heralded as symbolic of modern progress, the highway that is now being built by the Department of Antioquia stands incomparably high in romance. An engineering feat of first magnitude, it also represents the consummation of an ideal, the very soul of a people. Strangely enough, the fact that a river which is subject to dry spells was dry for a longer period than it had been previously for years furnished the immediate impulse for the beginning of this great enterprise. And now the people of Antioquia and of its capital, Medellin, may point with pride to the completion in August of the first 100 miles of this highway.

Somnolent Colombia came to the realization following the World War that she possessed a great abundance of natural resources of which she had not previously taken full advantage. In possession of these, she is more nearly

SOON TO LOSE THEIR JOBS

Pack animals have been used for centuries in Colombia. Those shown here are bringing in a knocked-down motor truck to be used by the contractors. The road will serve a large area



Photographs courtesy R. W. Hebard and Company, Inc.

WINDING LIKE A MAZE ALONG THE MOUNTAIN SIDES

The inscription on the back of this photograph reads: "A turn on the—" *A turn!* This is typical of the topography of the country in which the new highway to the sea is being built

comparable to the United States than is any other Central or South American country. She has iron, coal, gold, silver, platinum, emeralds, and many other things of lesser importance. In the production of platinum and emeralds she now leads the world.

COFFEE is the most important agricultural crop of Colombia, her annual production of this commodity being second only to that of Brazil. Despite her rugged topography, she is also a large producer of such staples as wheat, corn, sugar, cotton, and bananas. Cattle raising flourishes in the lowlands near the coast.

Although Colombia has a population of only about 8,000,000, she has an area of almost a half million square miles, or what amounts to almost one sixth the area of continental United States, or more than the combined areas of Germany, Denmark, Norway, and Sweden. Strategically situated, from a commercial point of view, in the northwestern corner of South America abutting on Panama, she is the only South American country touching on both the Atlantic and Pacific Oceans. She is fortunate, too, in having a wide range of climates, from the cooler temperatures of the mountains to hot, tropical sections on the Caribbean Sea and in the lowlands near the equator.

Needless to say, a country of such great size with so small a population, a desirable climatic range, and such vast natural resources, promises to become a vital factor in future world economics. Realizing that fact, Colombia has progressed greatly in recent years, has doubled her coffee production in 10 years, has taken the lead from Russia in the production of platinum, and is actively engaged in increasing her production of other staples. Her laudable plans for the future are entirely within reason for the native whites are industrious people who are still old-fashioned enough to have large families. It is not at all uncommon to find Colombian families of from 14 to 16 children, all of whom are hard workers. Colombia also has some Indians and Negroes. As for her political situation, Colombia has not been troubled with *opera bouffé* revolutions, such as occur sporadically in some Latin-American countries, for at least 20 years.

ANTIOQUIA, the richest, most productive department of the country, is situated in the northwestern part and has a relatively long coast line on the Gulf of Uraba, an arm of the Caribbean. With most of the advantages previously noted—as to natural resources, productiveness, and range of climate—Antioquia is divided, north and south, by four mountain ridges. The department is so rugged, in fact, that its people have a traditional saying to the effect that if the department could be flattened out, it would cover all of Colombia. Wits often quite soberly inform visitors that the natives plant their corn on the hillsides with the aid of shot-guns!

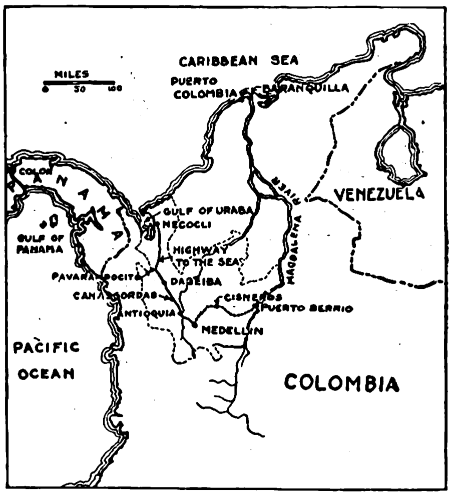
Medellin, the capital city, with an urban population of 120,000 and surrounded by a vast and important agricultural and mining district, is about 100 miles from the nearest point on the Pacific and 150 miles from the Atlantic, as the crow flies. From the nearest Atlantic port, it is 400 miles by air. At an elevation of 5000 feet, it is a city of eternal spring, its average temperature being 72 degrees, from which it never varies five degrees either way throughout the year. Its citizens simply have no weather to talk about. Americans bored by weather prattle, take note!

Medellin has a country club, modern hotels, and fine shops along with its many relics of ancient Spanish days. For, while it is one of the largest cities of Colombia, it retains much of the color and romance of its historic past.

Up to the present, Medellin has depended principally upon the rivers as trade routes. Most of the products of the surrounding country are brought to the city by pack-animal or ox-cart and, from there, they are shipped to the sea by a slow and uncertain route, by a combination of river-boat, ox-cart or truck, and railroad train

FOR the first 122 miles, the shipment is carried by train to Puerto Berrio. While formerly it was necessary to transfer the shipment near Cisneros to motor trucks or ox-carts for a two-mile trip over a mountain 7000 feet high and reload it on another train at Cisneros, a new tunnel 4¼ miles long at this point, to be completed in June, eliminates this "portage." At the river port, Puerto Berrio, it is loaded on boats for the 503-mile trip down the Magdalena River to Barranquilla. There it is again transferred to a train for the last 17 miles to Puerto Colombia where it is loaded on ships bound for world markets.

Shipments inward-bound for Medellin follow this same circuitous, inefficient route in the opposite direction. Mr. John H. Caton, Chief Engineer of the contractor for the new highway, states that: "Experience.... indicates that it frequently takes up to six months for freight to travel from New York to Medellin, three fourths of which time is accounted for after arrival at Puerto Colombia. The freight cost is always high and runs to



"CARRETERA AL MAR"

The old route and the new. The dotted line shows the Department of Antioquia

Engineering Library
Engineering Library

fantastic figures when the river is low." And even if the freight is promptly transferred to the river steamers, he says that "there is a likelihood of loss and damage due to lightly-built, shallow-draft vessels and a dangerous river which is swift and shallow, has a shifting channel, and is full of sandbars and snags. Its vagaries are unknown even to experienced pilots." Furthermore, dry seasons, which render the river unnavigable, often last for months at a time.

A SAMPLE OF WORKMANSHIP ON THE NEW ROAD

A half bridge and retaining wall on the *Carretera al Mar* just north of San Cristobal Pass. Numerous works of this nature were necessary along the stretch of road soon to be completed

THUS Medellin's problem was intolerable. If the city were to progress, something had to be done. The more far-sighted citizens had urged some sort of action for years but it remained for an exceptionally long dry season to give impetus to the movement and cause formulation of a definite plan. Once started, the plan met with instant and unanimous approval. *Carretera al Mar* became the rallying cry for progress—progress for Medellin and the surrounding district.

The Departmental Assembly authorized, in March, 1926, the immediate financing and construction of the first section of the highway. For the construction work, the Antioquians turned to America. The firm of R. W. Hebard and Company, Inc., New York, was recommended and the contract was given to this firm forthwith, without the formality of, or the delay incident to, calling for competitive bids. Construction was begun in September, 1926, and the first section will be completed in August of this year. As soon as possible, the remainder, making a total length of 255 miles, will be authorized.

The engineering and construction staff has been composed chiefly of Colombians and Americans, with the former predominating. Mr. John H. Caton is chief engineer for the contractors and Dr. Eduardo Orozco, of Medellin, is chief engineer for the Highway-to-the-Sea Commission, the president of which is General Pedro J. Berrio, Governor of Antioquia.

PICK, SHOVEL, WHEELBARROW

Excellent and cheap hand labor moved practically all the earth and rock excavated on this section from Medellin to Dabeiba

The nature of the country made it necessary to transport motor trucks and working equipment to the scene of operations by pack-mule. Once a subgrade was constructed, trucks and tractors brought in rock crushers, concrete mixers, compressors, hoists, rollers, et cetera. Much dynamite was used in making cuts through solid rock, but hand labor—pick, shovel, and wheelbarrow—moved practically all the earth and rock. Hand labor is cheap and excellent in Colombia.

BY this method, excavation and movement of over 5,000,000 cubic yards of earth, 70 percent of which was rock, was effected during the first 26 months. Hand labor also constructed retaining walls totaling over 50,000 cubic yards, 44 miles of tractor roads through wild forested country, bridges, pack trails, and drainage ditches.

From Medellin, the completed section of macadamized highway stretches over extremely rugged country in a northerly direction, crosses the Cauca River near the ancient city of Antioquia, passes the cities of Boqueron De Toyo, Canasgordas, and Uramita, and finally terminates at Dabeiba. The obvious reason for beginning the road at Medellin rather than at the coast is that the Medellin area is by far the more thickly populated.

From Dabeiba, the road will run, when finally completed, for 33 miles through rough canyon country. Reaching the valley floor, it will then pass through tropical forested country, uninhabited except by Indians and a few Negroes. Finally reaching the Gulf of Uraba—an arm of the Gulf of Darien, itself an arm of the Caribbean—it will extend to whatever point is finally selected as the most suitable site for development into a port. Since the gulf is amply deep near the shore at Necocli, this town has been proposed as the future port.

IT is estimated that the daily through freight over the completed *Carretera al Mar* will be in the neighborhood of 700 tons, about equally divided in each direction. Motor trucks will be able to make the trip between Medellin and her new outlet to the sea in 25 hours. Passenger automobiles, however, will make the run in from 10 to 12 hours.

As a scenic route, the new road will be equalled by but few others in the world. Since it will bring Colon, Panama, within two days traveling distance, many are confident that tourists in constantly-increasing numbers will drive along this snakily-winding road, will come to revel in Antioquia's charms, to scent the aroma of myriads of blossoming coffee trees, to find their youth again under the exhilarating influence of a delightful climate.

Limned against a background of slow progress, hard won in the face of insufferable difficulties, the *Carretera al Mar* stands out as a thing apart, evidence of a battle fought and won, a far-flung challenge to the gods of the destinies of nations, a genuflexion to Fortuna. And while Antioquians shout their huzzahs to the skies, Fortuna will return to them profits tenfold and the world, in turn, will share in their prosperity.

Our Point

Health and Happiness

AT the recent annual meeting of the National Academy of Sciences, Dr. Ales Hrdlicka gave out some astounding news. He stated that scientists are of superior physique, strength, health, and longevity as compared with the average American. This fact, he said, has been shown by a five-year investigation of physical and physiological characteristics of members of the Academy, numbering about 250 foremost scientists of America.

We have a clipping, attributed to Bertrand Russell, which says: "Men of science, who have less difficulty than others in finding an outlet for their creativeness, are the happiest of intelligent men in the modern world since their creative ability affords full satisfaction to mind and spirit as well as to the instinct of creation. In them a beginning is to be seen of the new way of life which is to be sought; in their happiness we may perhaps find the germ of a future happiness for all mankind."

Coupling the two statements together we find, not the frail-bodied scientist so often caricatured, but a very human person whose happiness and health, as well as his intellectual achievements, are greatly to be envied. Thus must we revise our estimate of the cost—to the scientist himself—of the scientific life, and bestow our sympathy elsewhere. What is sorely needed now is some magical formula for giving vitality and happiness to another group of men whose lives are burned out, often futilely, in our behalf: the confirmed college professors.

Maritime Law Laxity

PRESS dispatches from London relative to the Board of Trade investigation of the *Vestris* disaster, bring to Americans news of sensational evidence which, if proved, points to a deplorable lack of regulations governing shipping from ports of this country.

The first officer of the *Vauban*, sister ship of the *Vestris*, has given evidence that the owners of the ill-fated vessel made a practice of falsifying their log records concerning the draught of their vessels. He stated that the owners were guilty of persistent overloading and of consistently careless loading. The London testimony further indicates that, in order to lift the *Vestris* to her Plimsoll level, while overloaded, many tons of ballast water were pumped out of her tanks several times during the past few years. The senior surviving officer of the disaster added his opinion that the *Vestris* was a tender ship—had too much top weight.

If the *Vestris* was tender by reason of construction, her cargo should have been stowed accordingly; but if tender by reason of careless loading, overloading, and pumping out of ballast water, then such operation of her was nothing short of criminal. If she *was* overloaded and that fact led partly to her foundering, then the United States may count herself an accessory to the crime that cost over a hundred lives because our laws did not require inspection against overloading!

What is to be done about it? Obviously, American shipping laws should be revised to cover such conditions. The International Conference for Safety of Life at Sea, which will probably be concluded by the time this is in print, will, no doubt, uncover other irregularities in shipping and indicate the necessity for more stringent regulations for sea safety. But, in America, we should not apathetically await the findings and formulae of the Conference; there are many things that we can remedy at once if only shipping experts will show them up.

What Science Signifies

EXAMPLES, filled with the romance of truth, might be cited by legions to show how this everyday, practical world has profited fabulously in the ordinary monetary sense by the most unpromising discoveries of the scientific research laboratory. One of the most interesting is that of Laue, the Austrian mineralogist. Certainly when Laue proposed one day in 1912 to employ crystals of mineral as a diffraction grating for X rays no one foresaw that before 1929 this mere laboratory curiosity he had hit upon would be employed by the great steel industry to reveal the exact manner in which the molecules of steel rails and structural members of buildings were arranged, or the internal structure of a whole host of metals and alloys, and even for prying open the secret of the elasticity of rubber which man has not yet learned to imitate when he makes synthetic rubber.

What Laue believed he had found was merely a delightfully interesting method of verifying the pre-existing theory that the molecules in most forms of matter were arranged systematically like the rows, tiers, and layers of oranges in a box. No microscope had ever revealed visually a molecule and none ever can, for they are far more minute than the waves of light. But the tiny waves of X rays, about one ten-thousandth the length of those of light, although otherwise like in nature, happen to be just about the right length to match the dimensions of the molecule.

Thus when these waves or rays are directed at various forms of matter they do not reveal its molecular structure by the ordinary method of permitting us to see through it, but by rebounding from its rows, tiers, and layers of molecules at definite angles. When these angles have been measured—a simple procedure—the molecular structure of this matter has been "felt out" just as a blind man learns the contents of a room or a basket by exploring with his hands.

In actual everyday use the X-ray analysis discovered by Laue is an invaluable aid to industries the world over, and its economic value is incalculable.

The practical significance of a scientist apparently pottering over a bench covered with interesting apparatus was once brought out by the famous Huxley who said, "I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt cheap at the money. It is a mere commonplace and everyday piece of knowledge that what these men did has produced untold millions of wealth in the narrowest economical sense of the word."

Huxley's attempt to awaken a nation to the desirability of investing in scientists is far more apposite today that it was in the last century. A hundred thousand pounds—500,000 dollars—was much too cheap a price for any one of this trio of geniuses. Without risk of exaggeration we may value them at six ciphers higher. Watt made a mighty extension of man's power when he took the clumsy steam engines of his day and made them over into the smoothly running, flexible machinery of ours, so that they brought about the whole great "mechanical revolution" that all but freed man from physical labor and multi-

# of View

plied by hundreds the wealth of nations; Davy's safety lamp for miners might alone be said to have contributed untold advantage to industry, for it enabled the miners to get out of the earth the vastly increased tonnage of coal required to run Watt's engines; while Faraday actually discovered the working principle of the dynamo.

Late in 1895 the German physicist Röntgen discovered the X rays. This fact soon became rumored about in America and we can imagine that there must have been much the same kind of eager suspense among technical and scientific men during the weeks before authentic accounts were published, that took place last winter when the forthcoming publication of Einstein's newest theory was announced.

The first scientific journal to publish in America an account of this discovery by Röntgen of the X rays commented, "When the details reach us the process will probably prove to be of scientific value rather than of practical interest." Whoever ventured to make that prediction widely missed his guess. Most of us know that the X rays have proved to be somewhat "practical" at times! (The journal which made this prediction was none other than the one the reader now holds in his hands!)

Today scientists and editors of scientific journals are more cautious about such pronouncements than they were in 1896. They have learned that few discoveries, no matter how remotely they seem to pertain to anything practical, fail to find invaluable practical applications. No one has been heard to say that Einstein's recent effort to bring gravitation under the same laws as electricity will never be turned to practical account. The lesson has soaked in; science is a grab-bag and some of the things the worker gets hold of turn out to be immensely larger than they felt.

One might go on indefinitely recalling similar instances which point out the economic significance of science to the world. Everybody knows the end-products of scientific investigation because everybody uses them. But few know, because comparatively few take pains to inform themselves by careful reading, the stages by which these end-products have shaped up. Many see only what is on top. They accept, for example, the blessings of our knowledge of germs and germicides, without knowing how Pasteur discovered germs as the chief source of disease; they use a large variety of chemical compounds without knowing the meaning of chemistry; they admire skyscrapers, great bridges, and other complicated structures without knowing how Galileo laid the firm foundation of the laws of forces without which these structures could not be safely erected. They miss an infinitude of things which others see, because they do not take the trouble to read—perhaps more frequently because they do not know what books to read.

Relatively speaking, even today only a few carry on the advance of science. There are millions, otherwise intelligent people, whose outlook on the world is still essentially that of the Middle Ages. Alchemy still exists in active form; its votaries publish a special journal. "Hexing" is still rampant in one of the most prosperous regions of our nation. Plenty of people consider it just as well not to raise an umbrella in the house or walk under a ladder. A large number confuse science with pseudo-science and are easy game for all kinds of quackery purporting to cure bodily ills. Astrology, as mentioned before, is more popular than astronomy. The people of a sovereign state attempt to settle by referendum vote the question whether man is a product of organic evolution; for them to attempt a popular verdict on the Einstein Theory would be no less absurd. The world has a long way to go before it can be said to have come of age.

Withal, we progress.

Food for Thought

HOW many of us have gone into a drug store for medicines and been discouraged in our quest because of the array of coffee urns, dishes, and foods of various kinds! Our rage is voluble. How could a *restaurant* fill a doctor's prescription? Drug stores are going to the dogs, we tell the clerk who finally condescends to take care of our mere prescription.

Despite our misgivings, however, there may be scientific justification for the drug-store lunch counter. Dr. W. L. Scoville, who recently received the Remington Medal of the American Pharmaceutical Association, says so. Modern scientists have found that the distinction between foods and drugs is less pronounced than formerly and, in fact, physicians often ignore drugs entirely in certain cases and prescribe food diets, sunshine, and fresh air. Food has attained a high rank in the treatment and warding off of disease because of its vitamin and mineral content—about which little was known until recent years—and it is appropriate, therefore, for it to be closely associated with the sale of drugs.

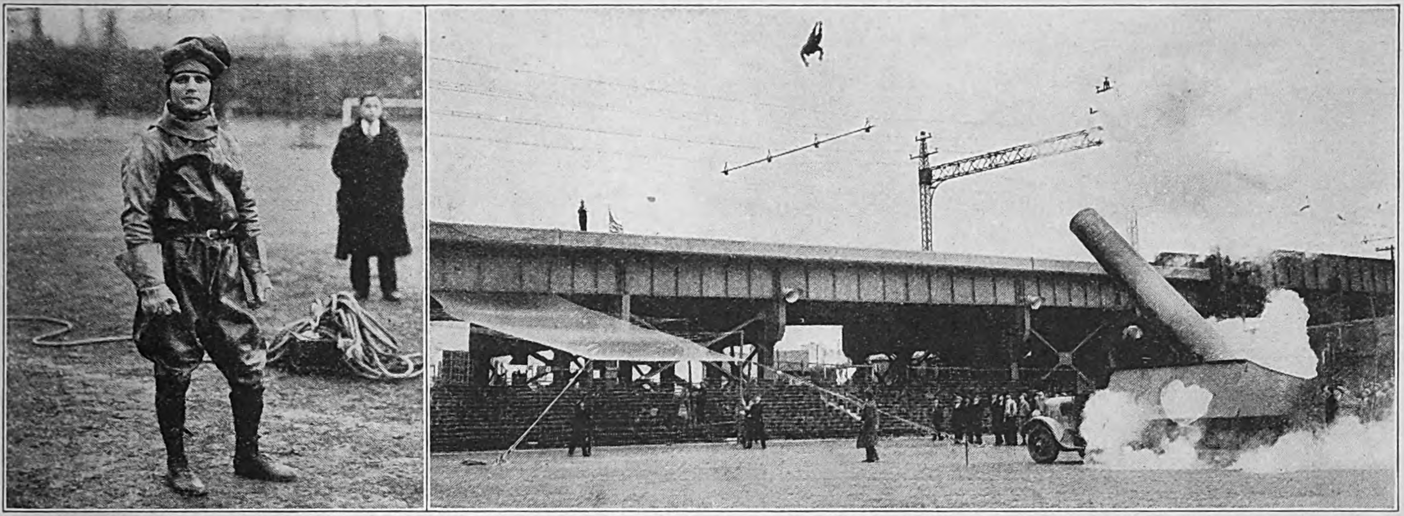
As for those drug stores that prostitute their space to the wares of department stores, words fail us. Too frequently they have failed to supply our drug needs through lack of supply, yet as we made our way out of the store, we have been harassed by the importunities of myriads of clerks selling toys, candy, books, electric irons, and heaven knows what!

Reforestation

FROM time to time we have pointed out the necessity for a practicable program for the conservation of our timber resources, and many other publications have done likewise. These appeals have not been unfruitful but, by their number and frequency perhaps, have stimulated a general interest in a vital question that has been brought to the fore only in the last few years. Many lumber companies are cutting selectively and some of them even replant land after they have cut it over; and various states have adopted plans for reforestation that will assure in future years a plentiful supply of yearly-maturing timber.

Besides their great lumber value, trees hold winter snows on watersheds and prevent the sudden thawing which so often results in spring floods; they minimize erosion of soil by holding rain water in the undergrowth and the mulch of leaves; and, in summer, they may prevent the drying up of streams dependent upon underground seepage. Spring floods, soil erosion, and dry streams are in evidence in many sections of the country but usually little attention is given to their cause.

Every state in the union could, to its own profit, emulate the constructive conservatism of New York State. Already it has planted or sold for planting, around 20,000,000 trees. Seedling trees and young transplants are being sold by this state at the nominal rate of two dollars per thousand for seedlings and four dollars per thousand transplants.

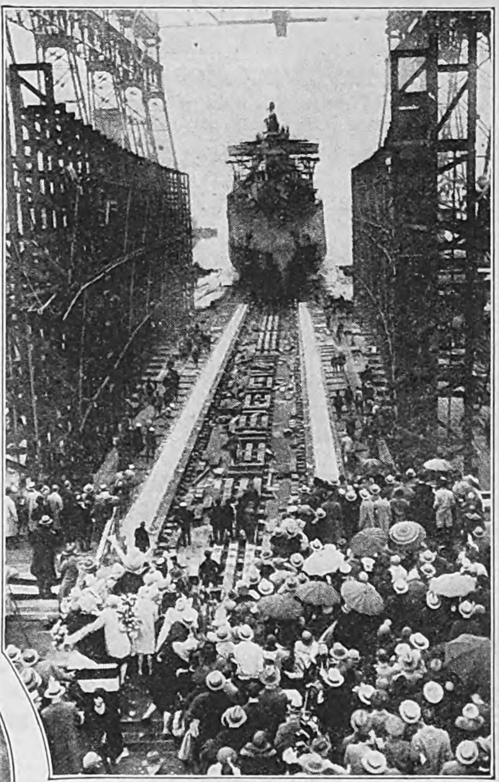


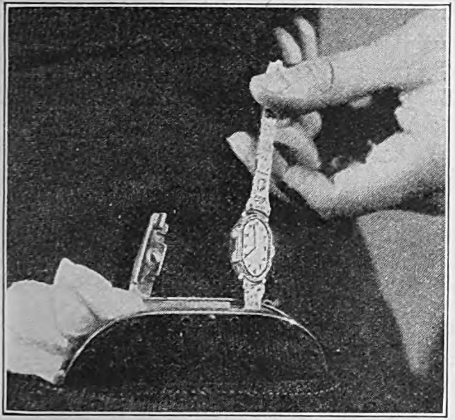
THE CIRCUS HAS A NEW HIGH DIVER—FROM A GUN

The old time high diver who used to thrill us by his spectacular leaps from a high tower into a water tank, has been outdone by Hugo Zacchini, now traveling with a famous American circus, who is shot from a gun daily as a feature of the program. At the left is shown Hugo, the daredevil; and at the right, Hugo, the projectile. The secret behind this feat is believed to be a spring which throws Hugo at the same time a small charge of powder is fired. He lands in the net shown at left

THE "PENSACOLA" GOES DOWN THE WAYS ➤

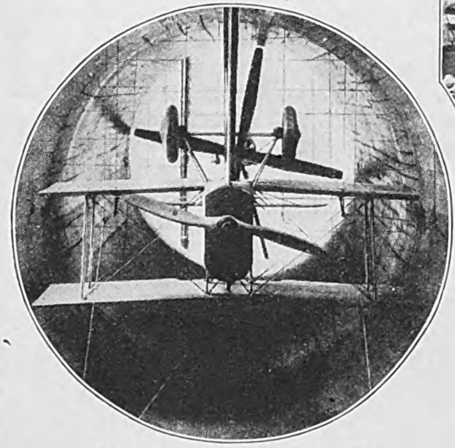
The *U.S.S. Pensacola*, second of the so-called Treaty Cruisers and a sister ship of the *U.S.S. Salt Lake City* which was launched recently (See SCIENTIFIC AMERICAN, May, 1929) was launched at the Brooklyn Navy Yard, New York, on April 25. She is the first ship to be constructed at the Brooklyn Navy Yard since 1919. She will have the same armament as the *Salt Lake City*, is 585 feet long over all, and has a beam of 65 feet 6 inches. She will have a crew of 530





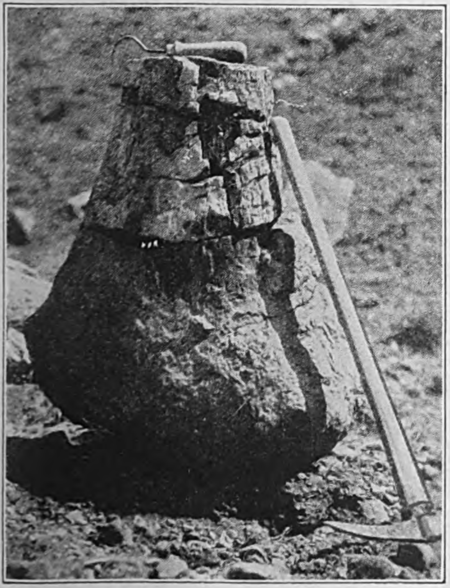
SURF SAFETY FOR VALUABLES

Seen on southern beaches recently, this water-tight purse will doubtless make its appearance on northern beaches soon. It is either woven into the bathing suit or worn attached to the belt. It provides a safe and, it is said, a dry receptacle for valuables, money, and cigarettes and matches



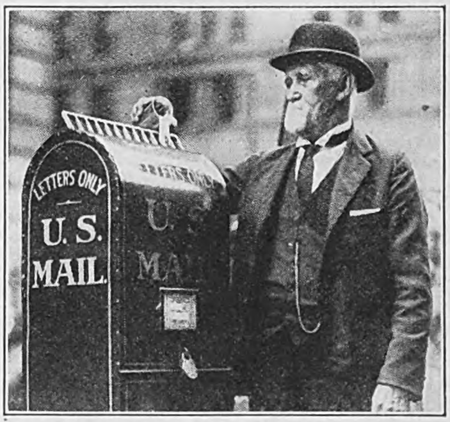
HOW THEY'RE TESTED

Unique view of a scale-model airplane being flight tested in the wind tunnel at the Massachusetts Institute of Technology. In such tests the models are always suspended upside down and their flight characteristics investigated



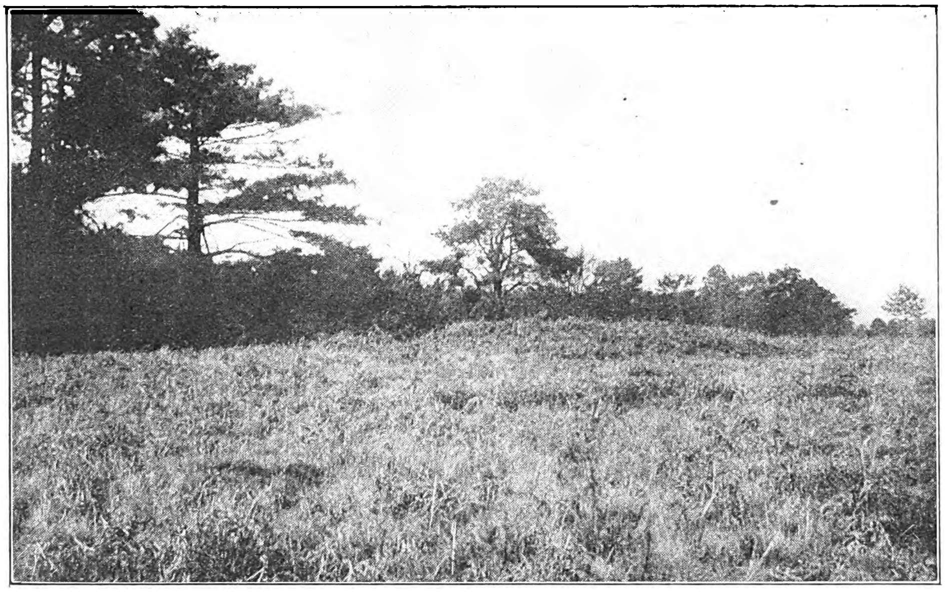
◄ A LITTLE LEG BONE

Part of a leg bone of one of the large dinosaurs of the Jurassic Age, recently found in the McElmo shale formations near Grand Junction, Colorado, by Mr. E. B. Faber. This bone, broken by exposure, now measures 22 inches across larger end. There are many dinosaur remains in the McElmo formation



NO WATER-SOAKED MAIL

Mr. L. A. Stelhouse of Baltimore, Maryland, pouring a glass of water into a mail box which he has invented and recently demonstrated to Post Office officials. Water which enters the mail chute at the top runs out at an opening in the rear without dampening the contents of the box



THE LARGER OF THE BRONZE AGE BURIAL MOUNDS

Figure 1: The mound does not show very distinctly, owing to the vegetation which tends to camouflage it, but when seen at the site such a round burial mound is a clean cut feature

The Invaders of England

An Account of the Excavation of Early British Burial Places

By J. REID MOIR

Fellow of the Royal Anthropological Institution, Member of l'Institute International d'Anthropologie, Past President of the Prehistoric Society of East Anglia

AFTER the departure of the Romans from England, when the greatest empire the world had ever known was declining to its fall, a series of raids and invasions by people living across the North Sea began.

While the Roman power was in force in Britain these attacks had been guarded against and repulsed, but its withdrawal inaugurated a period of strife and bloodshed which lasted for a considerable time.

It was in the east of England that the worst of these struggles took place. All up and down the coast, and on the broad estuaries leading inland, are to be found abundant traces of the invaders who at this epoch entered the country.

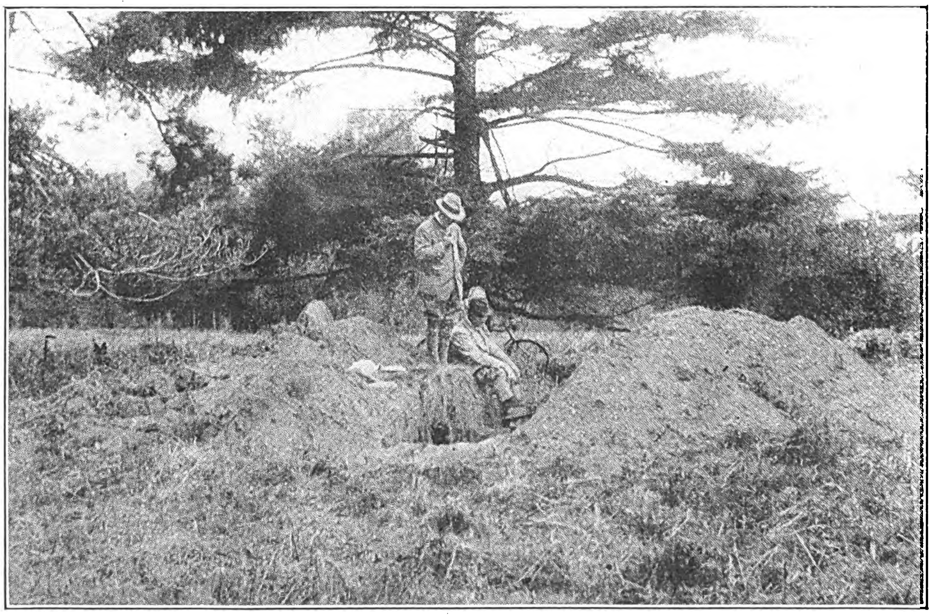
ALTHOUGH there are in existence no actual written records of what then took place, the evidence of sanguinary fighting, in the form of dismembered human skeletons, is often unearthed, and the necessity for defending their hearths and homes must have come to the East Anglians of these days with a frequent and deadly insistence. That this was the case is shown by the inclusion in the litany read in the East Anglian Churches of this period of the supplication, "From the fury of the Northman, O Lord, deliver us."

Those who are familiar with the low-lying coast of Essex, Suffolk, and Norfolk and of how with the oncoming of night the sea-fog reduces visibility to a minimum, can form some idea of the state of tension which must have been present when it was known that ruthless invaders were waiting for just such an opportunity to carry out a raid. Running up the eastern coast line is a sand-belt some 12 miles in width, which gives rise to some of the most beautiful scenery in this part of England. The country is undulating, intersected by wide estuaries and river valleys, while pine trees, heather, and gorse flourish abundantly, and give shelter to innumerable birds of the English heathland species.

At certain places on the high ground between the river valleys the sandy country is flat, and very often on these places are to be seen a number of round burial mounds of the people who, many centuries ago, crossed the North Sea in search of new and unexplored country. About three miles to the east of the town of Ipswich there exists a wide flat plateau about 150 feet above sea level, where a number of these mounds are present, and recently I carried out on behalf of the Ipswich and District Natural History Society, an investigation of two of the burial places. (See Figure 1.)

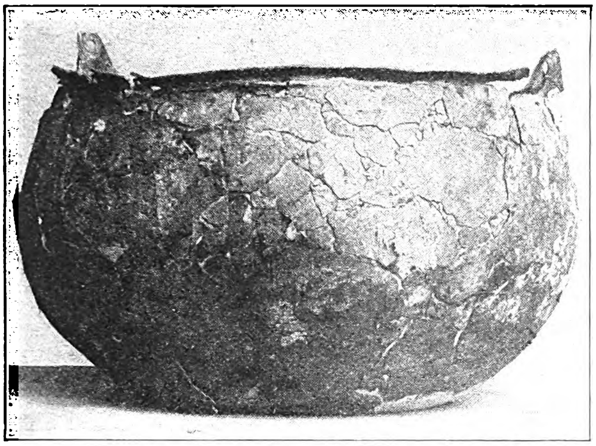
IN England the round barrows, as they are called, are generally of Bronze Age date, while the long examples are referable to Neolithic days. Strange to say, although numerous and very fine flint implements of the latter epoch have been found in East Anglia, not a single example of a burial mound of Neolithic times has yet been discovered in this area. But those of Bronze Age and later date are numerous and it was in two of these that excavations were undertaken. The mounds, which were of unequal size, lay close to each other and the larger was first attacked.

The investigation showed clearly not only the age of the barrow but also how it had been constructed. An area had first been cleared and dug to a depth slightly below that of the surrounding ground level and it was in this ex-



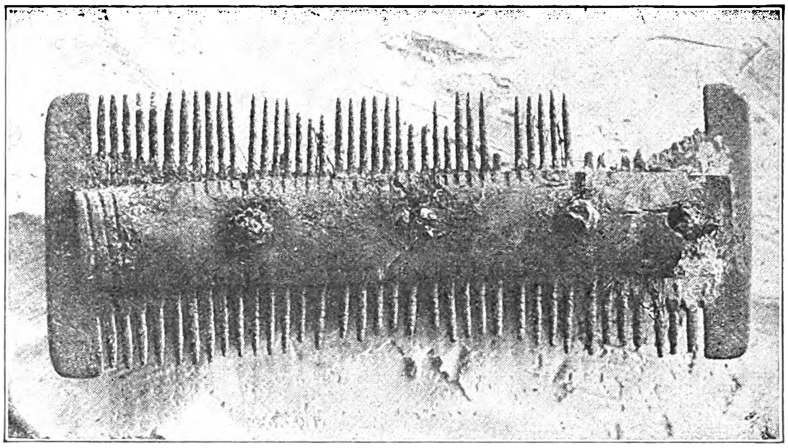
THE SMALLER OF THE TWO MOUNDS WHICH WERE OPENED

Figure 2: This was of Anglo-Saxon age. It supplied the artifacts shown on opposite page. Mr. Moir, the author, is seated on the edge of the opening, overseeing the laborer's work



ANGLO-SAXON BRONZE BOWL

Figure 3: Although made of bronze this should not be confused with Bronze Age date—we still use bronze



BONE COMB OF ANGLO-SAXON DATE

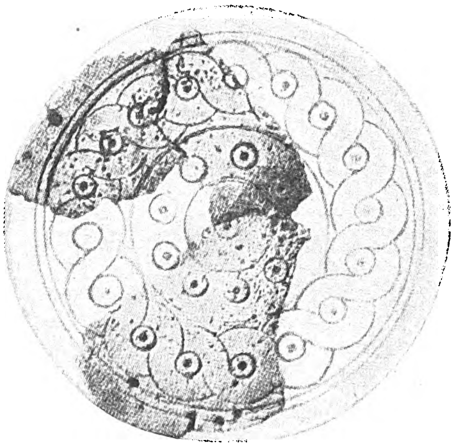
Figure 4: Natural size. Found within the bronze bowl shown at the left. Historians have comparatively little knowledge of the Anglo-Saxon period

cavated portion that a burial of Bronze Age times had taken place. Although the sandy nature of the soil had precluded the preservation of the human bones, we found numerous and unmistakable fragments of Bronze Age pottery scattered about, and with them a great number of small but very well-flaked flint scrapers. The quantity of these discovered, and their distribution, points clearly to their use as a funerary offering, showing that even in Bronze Age days flint implements had already begun to have a magic significance. After the scattering of the pottery fragments, and the flints, a low rounded mound of earth was erected over the burial and the ceremony apparently ended by the lighting of a large fire on top of the barrow.

THE smaller mound investigated proved to be of even greater interest (Figure 2). It was evidently the custom of the Anglo-Saxons to erect tumuli over their dead, and frequently to do so close to the burial mounds of much earlier times. This was the case in the graves examined to the east of Ipswich, as the smaller tumulus contained relics of pagan Saxons. In the center of the mound was discovered a beautiful vessel of beaten bronze (Figure 3), of an extreme thinness, which had evidently been used as a receptacle for the cremated remains of the dead. Unfortunately, a rabbit had made its burrow actually through this vessel, but in spite of this, many interesting relics were recovered.

The human bones represented more than one individual, among them a very young child, and with them were two bone combs with iron rivets (Figure 4), chessmen made of clay, remains of ivory bracelets, and part of an ornamented disk of bone (Figure 5). From the nature of the majority of these objects it is possible to conclude that this was a grave of female Anglo-Saxons buried with some of their personal ornaments. When the remains had been placed in the bronze vessel, a piece of canvas-like material was placed over the mouth and tied round the rim with something corresponding to modern string, for pieces of these materials were actually present when the bronze bowl was found, and can be seen still attached to it in the Ipswich Museum.

The earliest graves of the people who invaded East Anglia in Saxon times are found upon the banks of the Rhine, and the progress of these people westward can be traced by the funerary and other relics which they left behind them. A very extensive burial ground situated upon the south bank of the River Gipping in Suffolk, was discovered at Ipswich some years ago by Miss Nina Layard, when a remarkable series of weapons and ornaments came to light. No less than 159 graves were found, and from them Miss Layard recovered quantities of beautiful beads, iron spear heads, knives, shield bosses, brooches of rare Anglian type, bronze buckles, double toothed combs, earthenware pots, glass drinking cups, and other relics.



DISK OF BONE

Figure 5: Only the shaded parts were found. The rest of the disk is a reconstruction

The bodies had been buried in the extended position, and the bones unearthed point to a well made and robust race of people. The weapons were laid close to the side of the deceased, and while the male skeletons were accompanied by spear heads, bosses of shields and knives, those belonging to females were associated with jewelery, consisting of brooches, necklaces of beads and silver pendants. With the women were also buried their household utensils, such as iron pot-hooks, keys, and spindle whorls together with toilet requisites, including combs and similar objects.

THE Ipswich cemetery of pagan Saxon times is probably to be referred to about the Sixth Century, and its discovery, together with that of the burials on Markesham Heath, indicate that these people had settled down permanently and were living an ordered life in East Anglia. These and other discoveries of a like nature are helping us to form some idea of the condition of affairs existing in England after the departure of the Romans. But, although the Saxons had succeeded in largely subjugating East Anglia, they were there as conquerors with all the responsibilities such a position imposes. They had to maintain themselves in what was without much question a definitely hostile country and although they were able to do this, and were possessed of a civilization by no means to be despised, yet the Saxons must have presented a violent contrast to the Romans under whom, for over 400 years, England had been dominated.

The remains left by the Romans—gigantic walls, roads, and buildings of various kinds—testify to the greatness of these people and to the excellence of their methods of building. In the case of the Saxons, it is almost solely by their burial grounds and mounds that we know anything tangible about them.

Today, where the pagan Saxons had their burial ground on Markesham Heath in Suffolk, a large aerodrome exists, and the most modern flying machines rush through the air above the peaceful resting places of a long forgotten people. To visit this East Anglian scene is to witness the past and the present in startling contrast.

The Marvelous Machinery of Muscle

By Learning to Understand the Physics and Chemistry of Our Muscles We May Obtain Increased Control Over Them

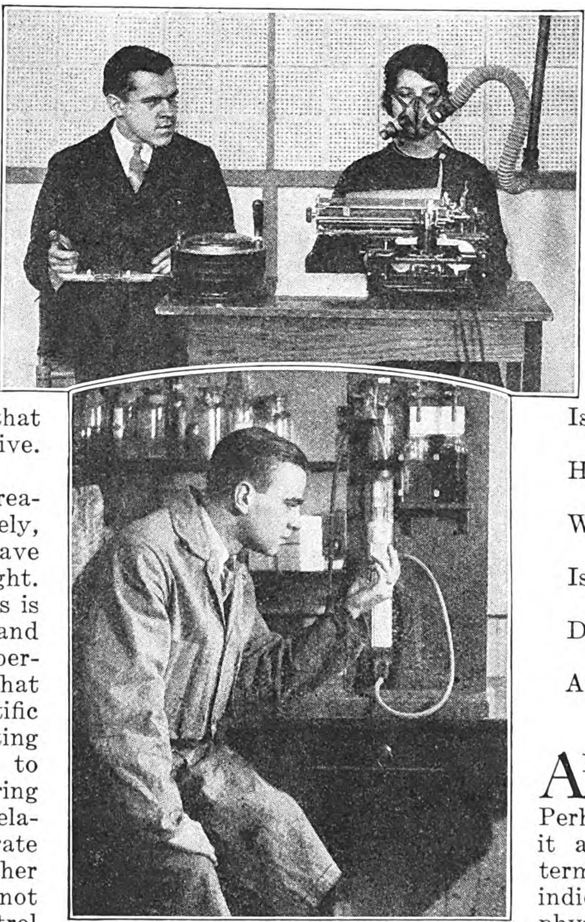
By **DONALD A. LAIRD, Ph.D., Sci.D.**
Director, Colgate Psychological Laboratory
Chief of Staff, Personal Analysis Bureau (Chicago)

COMING back from an evening engagement 80 miles from home a short time ago, my driver had to pick his way along roads covered with sheets of ice. Chains on all four wheels of the car helped, of course, but they could not offset the numberless hills we had to climb and the high crown on some roads constructed years ago. It was a continual struggle with the steering wheel for five tensed hours. I am still wondering how we kept out of the ditch time and time again. We passed fully two dozen cars that had landed in the ditch, and were unable to get out. Since no garage would hazard its wrecking cars on the slippery roads, the ditched cars had to remain where they were until a thaw or snow relieved the perilous condition of the roads. We came through without a scratch, although it was so late when we finally came home that the family was somewhat apprehensive.

THERE are two predominant reasons why we came through safely, when more cautious persons might have stopped at the first inn for the night. First and foremost in these reasons is the fact that Lester is a skilled and very careful driver. Second, and perhaps equally important, is the fact that I had just finished outlining scientific information preparatory to writing this article and now applied it to Lester's muscles while he was steering the car. His muscles were still relatively fresh and retained an accurate control of the wheel after other drivers' were worn out and could not maintain their usually skilled control in steering.

Rear-seat drivers as a rule are more of a pest than the person who has already heard all the humorous stories you want to tell him. This is the first rear-seat driving I have done, and it was so successful that I almost feel like starting a course in the Psychology of Rear-Seat Driving. This course would not teach one to tell the driver how fast to drive, but how to help the driver save his muscles and still maintain accurate control over them after five hours of extremely taxing work.

The rear-seat guidance on this night consisted of providing the driver with candy; stopping every 20 minutes for a five minute rest, during which four minutes were spent stretched out in the rear seat and breathing deeply after one minute of looking at the chains; using positive suggestions by saying to Lester from time to time, "We're keeping in the road splendidly," rather than giving a negative suggestion by saying "It's a wonder we didn't go into the ditch that time"; and teaching the driver to move his muscles slowly when turning the wheel rather than quickly and forcibly when the car started to slip toward the ditch. (Incidentally this also lessens the skidding hazard, although it was included primarily to save fatigue and thus retain control).



MEASURING ENERGY

Top: Air exhaled from the lungs is collected through a short piping in a large rubber bag. The mask on the typist's nose and mouth has two rubber flutter-valves, one to allow room air to be breathed in, and the other to open on exhalation and allow expired air to pass into the bag through the piping. *Below:* After being thoroughly mixed up, the air collected in the bag is passed through a meter to determine how much is exhaled per minute, and a sample of the exhaled air is then analyzed by this apparatus to determine the percentage of carbon dioxide and oxygen it contains. From this the energy may be calculated

This is but one typical emergency when a knowledge of the inner workings of the machinery of muscle yielded better control over the situation. There are almost innumerable practical situations in which the answers to the following questions will prove invaluable:

Are there some foods which give a better control of muscle?
Is energy saved by moving quickly?
Why will heavy work with one arm tire out the entire body?
Does climbing up stairs require more energy than walking on the level?
Is it nerves or muscles that give strength and power?
How many horsepower can the average man exert?
Will deep breathing help one to recover from fatigue?
Is walking rapidly better for the muscles than walking slowly?
Does massaging help the inner machinery in muscles?
Are muscles as efficient machines as automobiles?

ALL body machinery is predominatingly chemical and physical. Perhaps some day we will understand it and guide it better in electrical terms, since experimentation in general indicates that the chemical and physical often resolve themselves into more basic electrical phenomena. But there is a vast vista of chemical and physical knowledge available about these essential muscle machines which is sufficient in itself to permit gaining much practical understanding about our muscles. A practical mastery of muscle, however, requires more than complete chemical knowledge.

The foremost authority on muscle, Dr. A. V. Hill,* the distinguished London scientist, has recently pointed this out. "With this machine intelligent human beings have to work," he says, "aided by moral qualities of courage and resolution. Some will

---

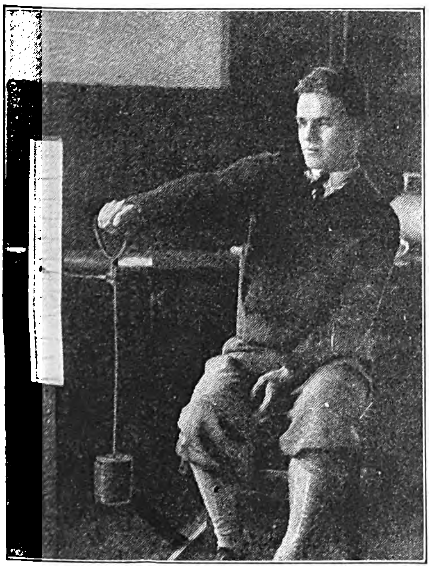
*See A. V. Hill, "The Scientific Study of Athletics," Sci. Am., April, 1926; also "Are Athletes Machines?" Sci. Am., August, 1927.—*The Editor.*

work their machinery better than others. Some will fail by lack of the necessary mental qualities, by lack of the necessary skill. Some will neglect to keep their machinery in order. Others will fail for lack of resolution." And Dr. Hill knows what he is talking about in more than a dry scientific way—he is no mean athlete himself.

Knowing the dynamics of muscle chemistry will not provide the courage and resolution and perseverance. But it will make the courage more fruitful. It should give courage, for example, to learn that a trained runner develops around seven horsepower of mechanical energy from the chemical transformations in his active muscles!

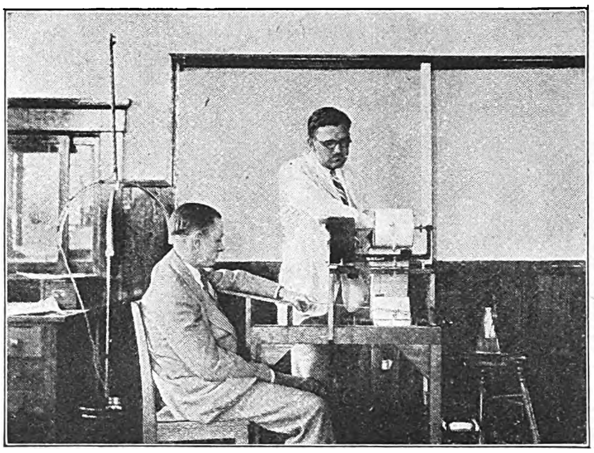
It should give still more encouragement to discover that one of the most efficient engines in the world is that of our muscles. A steam engine with a modern condenser has an efficiency of about 15 percent—if it is a good engine. This means that for every 100 calories of fuel energy consumed under the boilers, the engine returns only about 15 calories of productive mechanical energy. Gasoline engines have an efficiency of from 20 to 25 percent. Expensive Diesel engines have an efficiency of 20 to 35 percent. The trained athlete may have a muscular efficiency of more than 40 percent!

The fuel burned by muscles is in the form of a sugar known as glycogen. Each contraction or twitch of a muscle uses up some of this glycogen. The fire draft which supplies oxygen to the muscles so they can burn the glycogen as it is needed is the red blood cells. These take up oxygen from the air in the lungs and carry it throughout the body, and a working muscle which needs oxygen takes it up from these red cells automatically—like an automatic thermostat which opens and closes the furnace drafts at home.



MUSCLE MECHANICS

There is less fatigue and greater strength when the weight is held palm upward—about 10 pounds more can thus be held



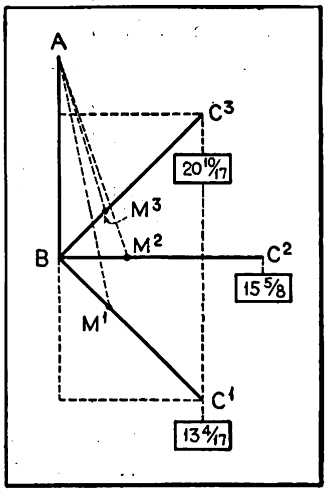
WORK RECORDER OR ERGOGRAPH

This apparatus measures muscle fatigue. The subject is flexing his middle finger against a spring until the muscles are exhausted by the many repeated efforts

A hard working muscle will require more oxygen than can be brought to it by the red cells. But unlike the basement furnace the muscle does not stop work at once; it keeps on working in a fatigued condition and runs up what is called an oxygen debt.

It can not keep this up long, but it is done every day in running to catch a train or to answer the telephone, in doing the week's washing, and in some modern dances. Whenever one's working rate changes it takes some two minutes for the rate of oxygen intake to adjust itself to the new demands. The oxygen follows, does not cause.

Two apparent poisons are given off when muscle engines work. The glycogen becomes split into lactic acid and carbon dioxide. Lactic acid is produced every time a muscle works. The faster it works, the more acid is formed. If the muscle is working especially hard, the acid is produced more rapidly than it can be removed. It accumulates. A hard working man is more acid than the resting man!



ARM STRENGTH

Chart showing relative strength of the arm in different positions. AB represents the upper arm, BC the lower arm. AM diagrams the muscle. Assuming the muscle to be exerting a force of 50 pounds pull with the arm in position ABC¹ only 13 4/17 pounds can be lifted, while at position ABC² the same force of 50 pounds pull will lift 15 5/8 pounds, and in position ABC³ 20 10/17 pounds. This explains why the waiter raises his tray to a high carrying angle analogous to position C³

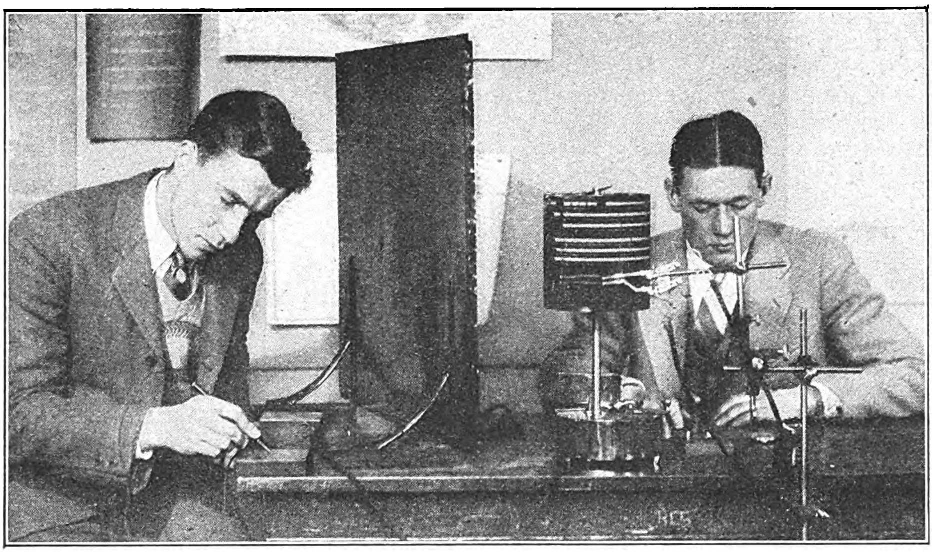
Only one arm may be used, but if it is exercised strenuously enough so much lactic acid will be accumulated that it will be carried by the blood to remote parts of the body. If it accumulated solely in the arm muscle it would quickly stop activity. But when diffused to other muscles in the body it may make them tired. So exercise in one part of the body may make the entire body tired! There is a bright side to this picture, however. When the lactic acid is carried to lodge in other muscles there is more oxygen available to counteract it than if it remained in the arm. We actually may recover from a tired arm in our legs! This is something the steam engine cannot do.

Another miracle which makes muscle more efficient than a steam engine, even with condensers for bringing the exhaust steam back into the boilers, is that the oxygen acts upon the lactic acid to restore much of it to glycogen. As much as three fourths of the glycogen may be restored.

Muscles in different parts of the body vary in their ability to re-form glycogen, and in their ability to withstand amounts of lactic acid before they stop working; some of them do more work, although consuming less glycogen. Quickly moving muscles require more energy from the body than do slowly moving muscles. The red muscles are more efficient than the white or pale muscles.

Muscles of warm blooded animals are capable of twice the work of those of cold blooded animals. Insect muscles are even more powerful in proportion to their size—an apparent exception to the rule that slow movements are more efficient than quick movements. How great is this difference between warm and cold blooded animals can be seen from a comparison of the strength per unit of size of frog and human muscle. Per unit of mass the human muscle is from two to ten times more powerful.

Regardless of the relative power of different kinds of muscles, it is now obvious how deep breathing increases the oxygen available for combating lactic acid. The increase in available oxygen is slight in deep breathing, but tremendously helpful. If our atmosphere were to change so that there were more than the 20 percent of oxygen of our present atmosphere it is very probable that the



WHAT IS THE BEST RATE FOR TAPPING, TO PREVENT FATIGUE?

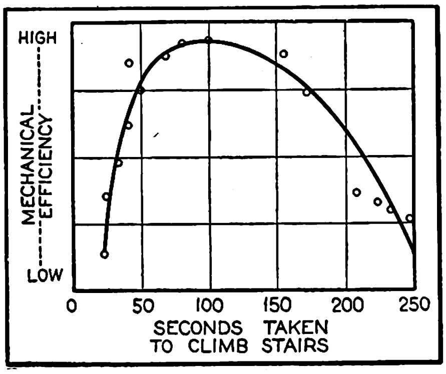
The smoked cylinder makes an electrically conveyed record. By a study of such records it can be ascertained that there is an optimum rate for a repeated effort of this type

resistance of muscles to lactic acid fatigue would be increased. This is proved by actual experiments in artificial atmospheres containing as much as 50 percent oxygen.

How well the blood can take up oxygen from the air breathed into the lungs is also important in determining how well they can fight lactic fatigue. Trained athletes carry more oxygen in their blood than ordinary persons—nature can be helped by training. In some diseases, such as anemia, the oxygen transporting power of the blood is lowered, making the patient tire quickly.

THE oxygen debt may take 30 minutes to be completely paid off after moderate exercise. After running 100 yards at top speed it may take an hour of rest for the oxygen debt to be paid. In the narrative at the beginning of the article the driver's short rest periods with complete relaxation—except for deep breathing—helped keep his oxygen debt low. His lactic fatigue had been partially offset, while other drivers were steadily acquiring a greater and greater lactic acid accumulation and oxygen debt. Even the trained runner has about four grams of lactic acid liberated by his muscles every second. Little wonder a race is exhausting.

Fatigue recovery is further helped by having an unrestricted circulation. No laboratory experiments have been conducted upon the effect of wearing a tight belt or corset upon fatigue recovery. Dr. Lindhard, however, has found that in exercises where the body is supported with the arms bent on gymnasium rings, the oxygen debt was increased by the blood supply to the active muscles in the arm being cut down by the pressure on the rings. Running is a most efficient use of muscles since the entire circulation is stimulated and the flow of oxygen carrying blood to all the muscles is facilitated. Working in a position which restricts the flow of blood acts in a way similar to the arm-pressing gymnasium rings. Sleeping in cramped positions—as in an attempt to keep warm—comes under the same category. The heart is doing a great deal in pumping 17 gallons of blood every minute; posture or dress may tend to force an increase in this phenomenal record which it is making every minute of our lives.



HOW FAST UPSTAIRS?

Actual records showing how in stair climbing if one goes too fast or too slow there is a lessened efficiency. The points of "high efficiency" are in actuality points of least oxygen consumption, mechanical efficiency being the inverse of the latter

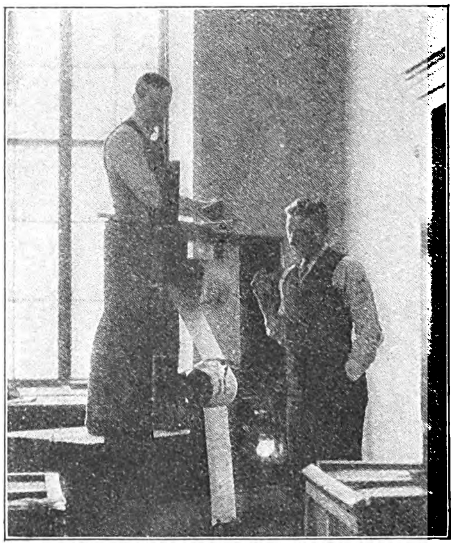
Common drugs, such as caffein, have unusual effects upon muscles. After a muscle is stimulated for a few seconds in a dilute solution of caffein it has a typical contracture, just as if the muscle were given a shock every few seconds. It acts to release slowly, but continuously, the series of chemical events which normally take place rapidly. The muscle may be given a brief stimulation by caffein and the contractures appear several hours later.

Various methods of using muscles yield varying efficiencies. In climbing stairs, for instance, the most efficient rate is one step about every second; every 1.2 seconds to be exact. This can be gaged individually without the help of a stop watch by counting "One—Mississippi; two—Mississippi; three—Mississippi; and so on." This comes close to indicating a second on each count. Stair climbing is actually about 15 times as energy consuming as covering the same distance on the level. Even stopping takes energy; the track athlete expends energy in stopping equivalent to running about another five yards at top speed.

THE fuel used up by the muscle, glycogen, is a carbohydrate. For a long time scientists were in controversy regarding whether fats could be used as muscle foods. It is now apparent that the body may transform fats into carbohydrate. But experiments by Krogh and Lindhard have demonstrated that muscular efficiency is highest on a diet that is predominatingly carbohydrate. This has been confirmed as the primary fuel of muscle by Dr. Furusawa, the Japanese investigator.

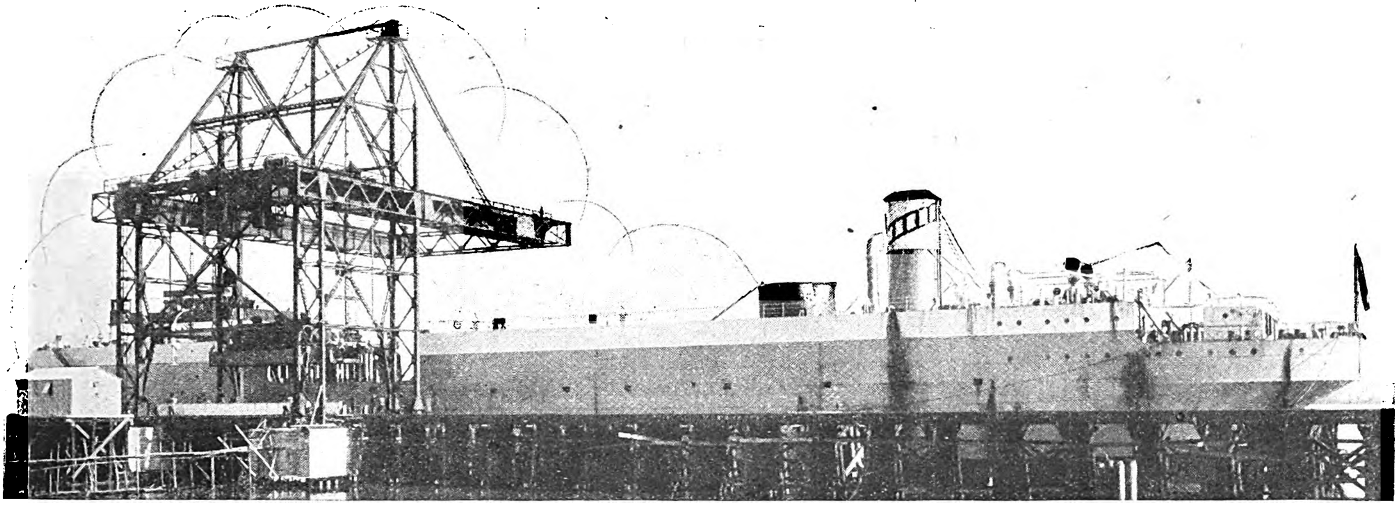
Foods which predominate in carbohydrate content are beans, barley, bread of all kinds (especially toasted), corn meal, crackers, dates, Farina, grape butter, hominy, honey, macaroni, molasses (cane), oatmeal, prunes, raisins, rice, Shredded Wheat, sugar (100 percent carbohydrate), wheat, and zweibach.

Foods may enter into muscular efficiency in another way. The oxygen-carrying power of the blood seems to be dependent upon the presence of iron. Foods especially rich in iron are almonds, beans, dates, eggs (especially the yolks), figs (dried), hazelnuts, lentils, meat (lean beef), oatmeal, prunes, raisins, rye, spinach, and whole wheat.



GIANT ERGOGRAPH

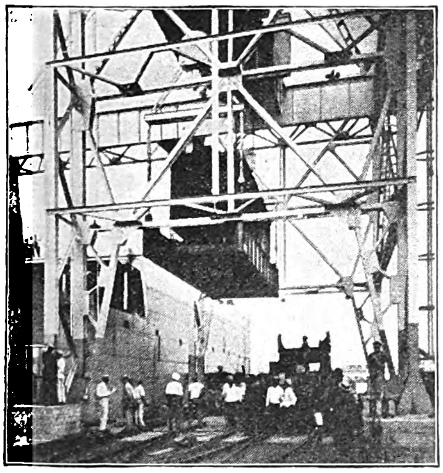
This is another work recorder, designed by David Campbell (right) which is used at the Colgate laboratory to determine the best ways of using the muscles of the arm and trunk. Note recording pen or stylus



A TRAIN GOES DOWN TO THE SEA IN A SHIP

Side view of the *Seatrain*, the car-ferry which plies between New Orleans and Havana, being loaded by means of the giant crane at a terminal port. Each car is raised on a platform, then lowered through the hatchway and rolled off at the proper level

A Ship That Carries Trains



A CAR IS HOISTED

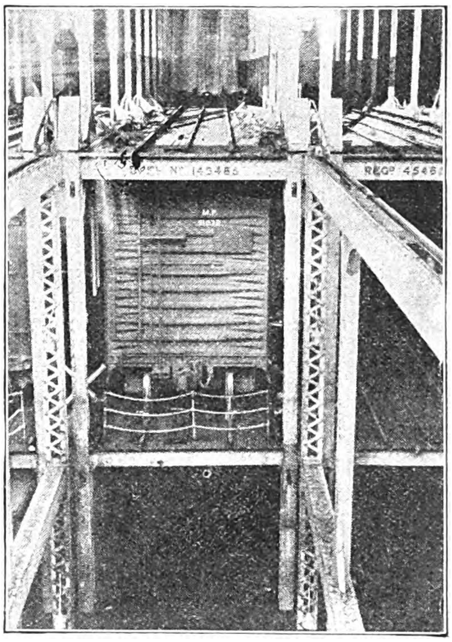
Close-up of the dock crane showing a car being elevated to the ferry deck

PRODUCTS shipped by water by the usual method of transfer from train to steamer, are subject to much loss and delay. Pilferage is a common occurrence on docks; breakage and loss due to sifting from bags and boxes cannot be prevented; and the necessity for frequent transfers causes considerable delay which may be particularly costly in the case of perishable freight. In addition, there is the possibility that rain may ruin cargo while it is on the docks ready for loading. This applies not only to perishable freight but also to heavy machinery from which crates have been omitted due to the freight cost of this added weight.

A short time ago a car-ferry service, employing a new type of car-carrying vessel, was inaugurated between New Orleans and Havana. The new vessel, appropriately named the *Seatrain*, was built in England under various American and foreign patents. It has a capacity of 95 freight cars. Weekly sailings will be maintained between New Orleans and Havana, the *Seatrain* making connections with railroads in each of these two cities. The voyage between the two ports requires in the neighborhood of 50 hours and, although we have received no recent report of the time necessary to discharge a cargo of cars and load a fresh complement, it was estimated beforehand that this would take about 10 hours.

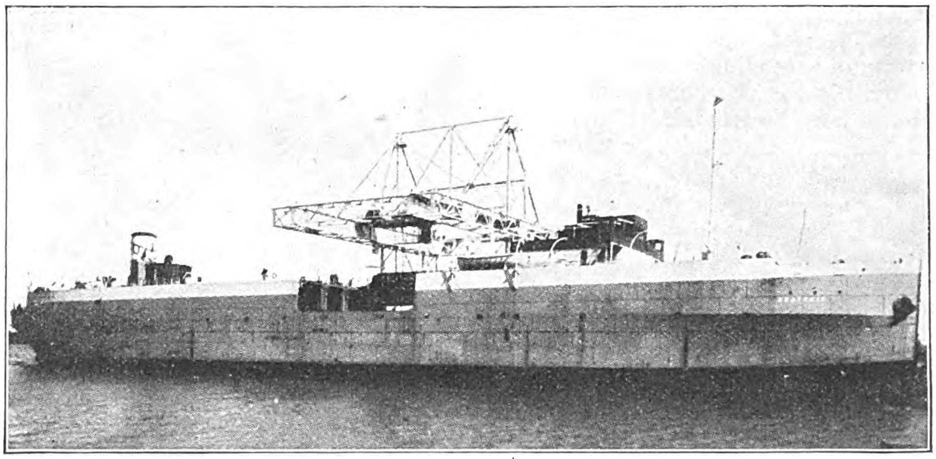
The chief novelty in the design of the *Seatrain* as compared with previous railway ferry-boats, is that the cars are carried throughout the holds between the decks and superstructures instead of on only one deck. At the terminal ports, special shore appliances in the form of huge cranes load and discharge the cars.

The length of the *Seatrain* is 427 feet 6 inches, and its maximum dead-weight tonnage is 10,500. The midship hatchway is 45 feet 8 inches long and is divided transversely at each of the three car levels into four sections.



STANDING ROOM ONLY

Interior of the *Seatrain*. Note car anchorage rails beside the standard car rails



AS THE CAR FERRY APPEARS FROM THE WATER

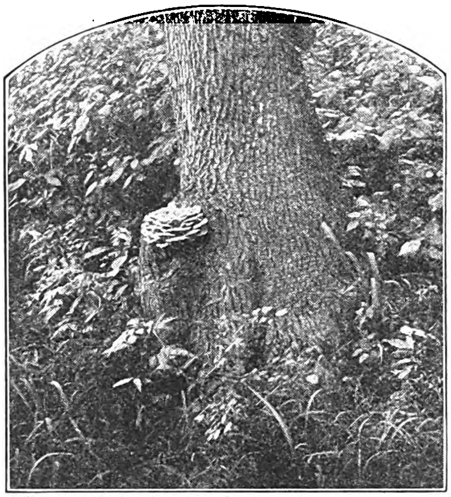
As will be seen, the loading crane extends over the full width of the ship. The vessel is trim and its deck is relatively clear. Note that the bridge is forward and the funnel aft

Neglected Mushrooms

The Common Meadow Mushroom Is Only One of Many Kinds Which We May Learn to Recognize and Eat With Safety

By WILLIAM ALPHONSO MURRILL

Author of "Edible and Poisonous Mushrooms"



All photographs by the author

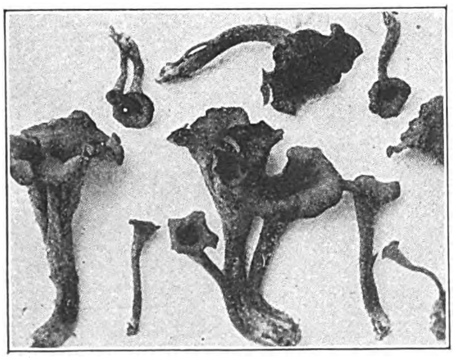
SULFUR COLORED POLYPORE

THERE is no doubt that large quantities of delicious food of the mushroom variety go to waste in our fields and woodlands every year. If we walk through the woods almost any day from July until the end of November, especially after frequent rains, we probably see and pass by a number of different kinds of edible fungi that are neglected even by those who recognize them or could learn to know them with very little trouble.

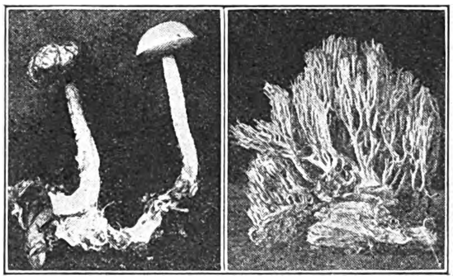
THE sulfur-colored polypore is one of these. I have seen at least a hundred pounds of it at one time on an old oak log, all fresh and inviting and ready for the oven. Few of our fungi are better when broiled or baked than this splendid species, which may be readily recognized by its size and brilliant coloring. The yellow or orange clusters appear on dead spots in trunks of oak, ash, and various other trees, which are seriously attacked by it.

The flesh is yellow, cheesy, tender in young specimens, and well flavored. On the under side are minute sulfur-colored tubes, which need not be removed before cooking. The frondose polypore, usually smoky-gray in color, is also edible when young and tender. Only one species in this entire group is poisonous, and that one is also very bitter and exceedingly rare.

Not only the polypores but also the boletes are neglected. These are fleshy fungi with tubes and a stem, occuring on the ground, while most of the polypores are tough or woody and grow on the trunks of trees or upon dead wood in the form of brackets. There are about 80 kinds of boletes in North America and nearly all of them are edible. A few are bitter and two are slightly poisonous; these are the sensitive bolete, which turns blue immediately when touched, and the lurid bolete, which has red or orange tube-mouths.

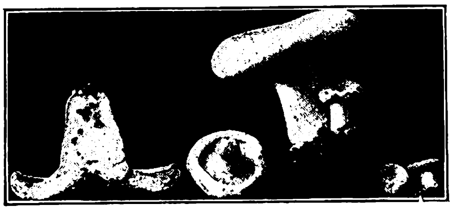


HORN OF PLENTY



Left: **FLUTED BOLETE**
Right: **A CORAL FUNGUS**

As an example of this group, I might mention the rare and beautiful fluted bolete, found occasionally in deciduous woods from Virginia to Alabama and westward to Ohio. Its unusually tall, yellow stem is decorated with reticulations and deep grooves, giving it a shaggy appearance; while the viscid, shining cap is reddish or egg-yellow, becoming darker with age. The pale flesh is slightly acid, but very palatable; only there is not enough of it. However, many of the boletes occur in great abundance and their flavor can hardly be excelled.



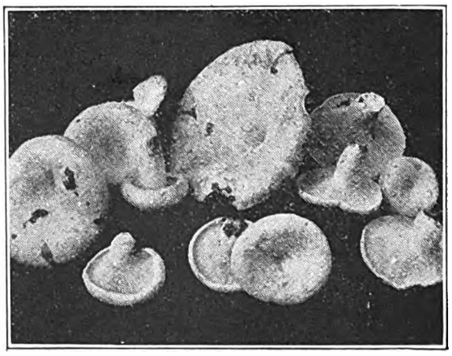
LACTARIA PIPERATA

Many of the coral fungi are no doubt eaten because none of them are poisonous, but the great majority go to waste. I knew one woman who started out very enthusiastically to collect the corals, but gave them up because she happened to get a bitter one the first time. This was discouraging, I will admit, but a little parboiling would probably have eliminated the trouble. Then, too, there is one very common white species that looks like a coral fungus but is too tough for the human stomach. Only fresh, tender specimens of mild flavor and free from insects should be used for food.

Most of the coral fungi occur on the ground in shaded places and are yellowish in color. *Clavaria pyxidata*, however, grows on wood that is dead and usually much decayed. It is of very wide distribution and easily recognized by the cup-shaped expansions at the tips of its branches and by its peppery taste. Its color is pale yellow when young, changing to dull ocher with age or on drying. Even the young, fresh plants are pliable instead of brittle, which is unusual for members of this group.

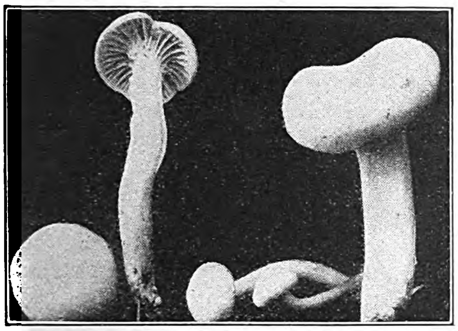
SPARASSIS is an interesting and rare edible fungus occurring on the ground in woods in the region of New York and Pennsylvania. It is four or five inches high, about six inches broad, and of creamy-white color. A very near relative is often seen in the European markets.

The horn of plenty, sometimes known as the fairies' loving cup, is a good edible mushroom, although unattractive in color and rather small. It occurs commonly in patches in open woods during summer and fall throughout a wide area of distribution in temperate regions. It is only two or three inches high, thin, rather flexible, trumpet-shaped, blackish-brown, and more or less scaly above.



LACTARIA PERGAMENA

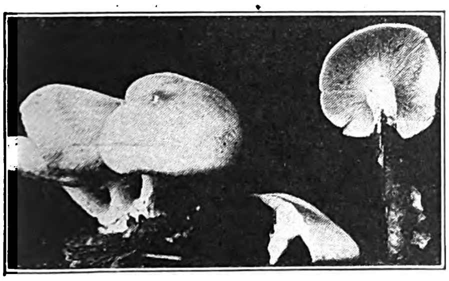
There is a large group of mushrooms readily known by their milky juice, but some of them are poisonous and it requires an expert to distinguish all the species. *Lactaria deliciosa*, with orange-colored milk; *Lactaria lactiflua*, with abundant white milk; and a few other species are commonly eaten by those who know; but one must be continually on the watch for *Lactaria rufa* and others of its category.

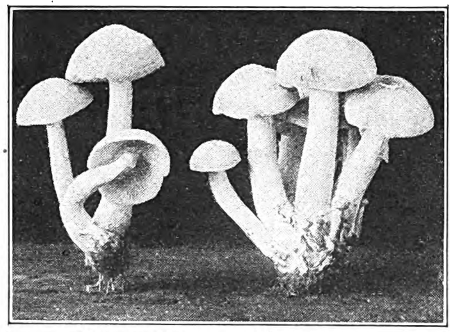

IVORY HYGROPHORUS

TWO species of this group are of special interest because they are not only edible but also exceedingly abundant and easily recognized. One is *Lactaria piperata* and the other *Lactaria pergamena*, both of them white and very peppery. The resin, "piperon," which is extremely acrid in the fresh state, is disorganized by heat and rendered harmless. Most of the acrid species with milky juice that are considered poisonous have other good characters separating them from these two.

Lactaria piperata occurs in dry oak woods throughout temperate North America, as well as in Europe. It reaches about four inches in diameter, is deeply depressed at the center, and has white milk that does not change color on exposure to the air. *Lactaria pergamena* differs in being somewhat smaller, with more crowded gills and less peppery milk, which sometimes changes to pale green on exposure. The white caps sometimes have yellowish or buff shades and the gills of fresh plants turn honey-yellow where wounded. This species is extremely abundant in oak woods from midsummer until autumn. I frequently pick a basketful without moving from my tracks. It is best to parboil it and throw the first water away.

The ivory hygrophorus is an attractive edible species widely distributed throughout the cooler regions of Europe and North America, occurring in moist woods or partially shaded places. I have found it very abundant on the Pacific coast, as well as in many parts of the eastern states. Its white color, slimy covering, mild odor, and distant, decurrent gills will serve to distinguish it. The caps rarely reach three inches in breadth.


FRAGRANT CITOCYBE

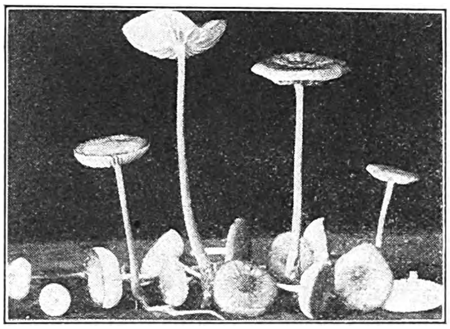

MANY-HEADED CLITOCYBE

THE rooting collybia is very fond of beech trees and I usually find the small, typical form in the vicinity of beech trunks or stumps, with its long rooting base attached to a dead root. The cap is about two inches broad, viscid when moist, grayish or umber; and the tall, slender stem white above and grayish below. Although small, the plants occur in groups and keep coming up for some time. A much larger form with hairy stem is less commonly seen in open deciduous woods; but both forms are widely distributed and of good flavor.

The fragrant clitocybe, with an agreeable anise-like odor, is not so abundant, but has unusual and beautiful colors. It loves deep leaf-mould in woods or wood borders, being found in this country from Maine to North Carolina and westward as far as Michigan. The cap is two or three inches broad, green or dingy-green (a rare color in mushrooms), fading with age or on drying. The short stem may be either white or greenish.

FOREST MUSHROOM

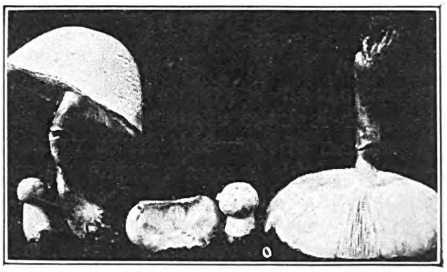
The many-headed clitocybe is such a valuable edible species that it should be cultivated, yet few persons know it or make use of it. It grew so abundantly on my lawn in New York that I often had mushrooms in plenty for days at a time without going away to collect them. Its flesh is so firm that it could be shipped clear across the continent, I believe, with little or no deterioration. This species is white or very slightly grayish and grows in large, dense clusters, the individual caps measuring from two to three inches in breadth. Unfortunately, the distribution is rather limited, so far as is at present known.


ROOTING COLLYBIA

IT is a little dangerous to recommend the smooth lepiota for food, because it might be confused with the destroying angel; but it is an excellent species, nevertheless, occurring abundantly on lawns and in pastures where the common meadow mushroom grows and readily distinguished from it by its white gills. The cap is two or three inches broad, white or slightly yellowish; and the stem smooth, white, bulbous below, and decorated above with a white ring. As the gills become old, they change to a dull pink. There is no death-cup as in the destroying angel; which, moreover, is a woodland species. If there is any doubt, better keep on the safe side!

The forest mushroom, of the same group as the common meadow mushroom, is a very attractive white species of wide distribution in open woods and wood borders, distinguished from the well-known horse mushroom by its smaller size and more simple veil. The cap is from two to four inches broad, white at first, becoming tinged with straw-color in age or when drying; the gills pale reddish-gray to dark-brown; and the stem white, abruptly bulbous below, with a large white ring above. If one can find enough for a mess, he will be amply rewarded for his search.

¶ *Hunting mountain goats with a camera is a sport as exciting as hunting them with a gun. An article in a coming issue will tell the interesting story of such a hunt.*


SMOOTH LEPIOTA

Tailor-Made Weather for Offices

Equipment in an Office Building in Texas Supplies Air of Proper Temperature and Humidity to All Offices

By RUEL McDANIEL

LAST August a new tenant in the Milam Building telephoned from an upper floor and complained that his office was too hot.

"Is your window open?" the superintendent asked.

"Why, certainly," the irritated and uninitiated tenant replied, "but that doesn't seem to do any good."

"Well," instructed the superintendent, "please close it at once."

This was strange advice to the new tenant, who had not acquainted himself with the novel facts concerning the new office building, as it is strange information for almost everyone who hears it; because the Milam Building in San Antonio, Texas, is one of the few office buildings in the world which have their own private "weather men" for manufacturing weather to suit the needs of their tenants.

ALTHOUGH for some years certain buildings, notably theaters, have been mechanically cooled—and theater cooling has progressed rapidly during the past three years—the Milam Building is the most completely equipped and most modern of any office structure in which an attempt has been made to regulate the temperature in a manner other than by natural ventilation in summer and artificial heating in winter. Because of the signal success which has crowned this large-scale venture in the regulation of the "weather" in office buildings, the Milam Building obviously represents the beginning of a definite trend in modern building construction. Many engineers who have seen this Texas building predict that within five to ten years it will be the exception for a modern office structure to be erected without equipping it with its own weather-making plant.

The Milam Building is a weather-world in itself. Theoretically the structure is air-tight, but actually there is an air leakage of about 5 percent. Regardless of how hot Texas weather may be outside in summer, the normal temperature of every office in this building is under 80 degrees in summer and above 70 degrees in winter, providing all tenants obey the rule against the opening of windows; and regardless of how cold it may be outside in winter, the temperature in every nook of the building is kept at the same comfortable level with but little variation. Yet a tenant may have the temperature in his own office regulated to his individual taste.

In summer when the humidity outside is stifling and perspiration pours in great beads off the brows of those who must move around, inside the Milam Building the humidity is reduced to a point so low that perspiration evaporates quickly after it comes to the surface of the skin and no one realizes that there is any perspiration. In winter when the average room is filled with air having a very low relative humidity due to the usual methods of heating, the manufactured atmosphere in this building is supplied with sufficient moisture at all times, and contracting colds by occupants is virtually impossible.

AN INDIVIDUAL "WEATHER WORLD"

The building in San Antonio which has the most complete weather-making equipment of any office structure

The fact that all air near the surface of the earth is heavily dust-laden is an important factor in the operation of the air-conditioning system of the Milam Building. Dust particles are bacteria carriers. Consequently to breathe dust-laden air not only produces inefficiency on the part of workers, but it is downright unhealthful. That is why, engineers point out, it is desirable that all breathed air be washed before it is used, and washing the air that is used in the building is a big part of the job of the Milam Building's mechanical weather man. Over-heating in summer causes fatigue and slows down workers; ordinary heating methods in winter lower the relative humidity of the air which, in turn, irritates the throats of those who breathe it, thereby subjecting them to colds and the ravages of other germs which ride upon the thousands of dust particles floating freely in every cubic foot of unwashed air.

THE modern weather-making equipment, therefore, performs two general functions: It regulates the temperature and humidity of the building; and it washes and purifies the air that circulates within the building.

Although the water which washes the air of the interior of the structure is cooled to a temperature of about 45 degrees and the weather plant has a refrigeration capacity of 375 tons a day, no ice is employed in this cooling and weather-making system. Two refrigeration units, employing a water-like liquid, cool the water to the desirable temperature through a process of compression and evaporation. The water in turn controls the temperature of the air which is washed by it.

Theoretically, every cubic inch of air that enters the building is artifically cleansed and regulated; but actually there is an inward leakage through the elevator shafts and lesser openings amounting to a small percentage of the total air in the structure.

There is a net loss of about 5 percent of the air in the building, through the same leakage escapes.

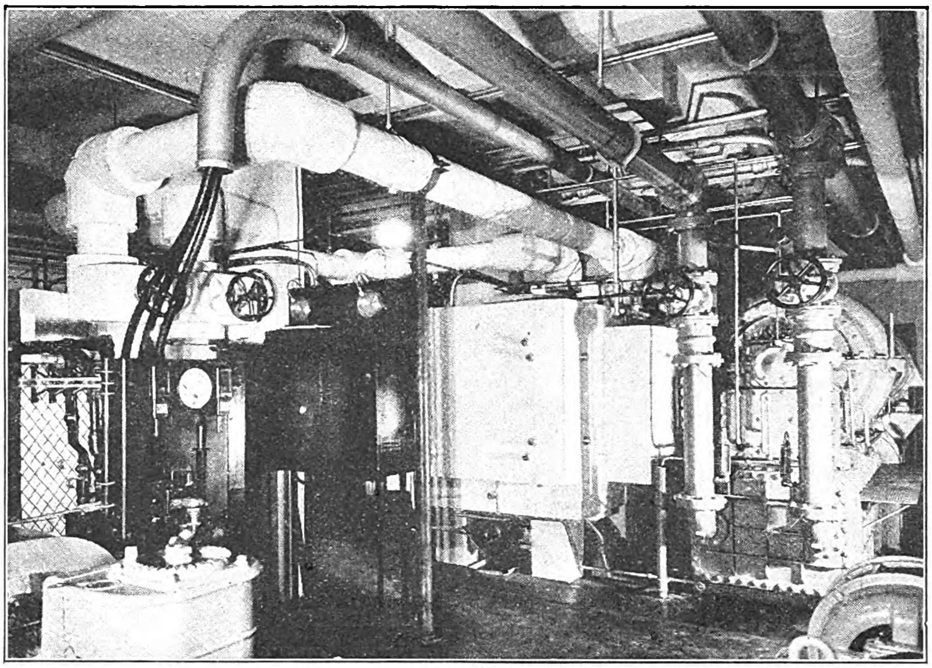
Under the system's normal control, it supplies 100 cubic feet of purified air per minute per person in the building, upon the basis of normal occupancy. The system provides a total of 210,000 cubic feet of air per minute. There is a complete change of air throughout the building every seven or eight minutes if all inlets and outlets in the various offices are normally open. The air-conditioning plant handles eight tons of air a minute!

Fresh air enters the building via the weather conditioning plant through a series of ports on the north side. A set of fans draw the air in from the outside, pull it through the spray of water, and discharge it, purified, into the various ducts for distribution throughout the building.

THE spray chamber is the heart of the weather plant. It is here that the air is both washed and conditioned to fit the needs of the average human system. The outside atmosphere brought in by the fans, is driven into this spray chamber which is almost airtight. Inside this chamber are vertical standpipes into which spray nozzles are screwed. Water is driven into these pipes and forced through the tiny holes of these nozzles under pressure. The result is a dense spray.

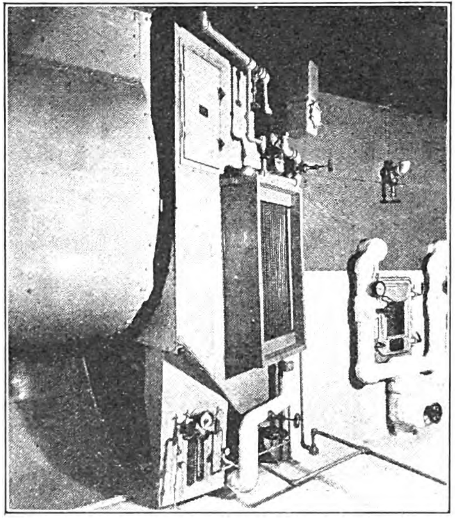
Incoming air is forced through this spray and is thoroughly washed. No air can enter the building without coming through this chamber, save the very small percentage of leakage through the elevator shafts and around the closely fitted outside double-glass windows.

So far, city water has been used in the spray chamber but an artesian well is available and may be utilized later.



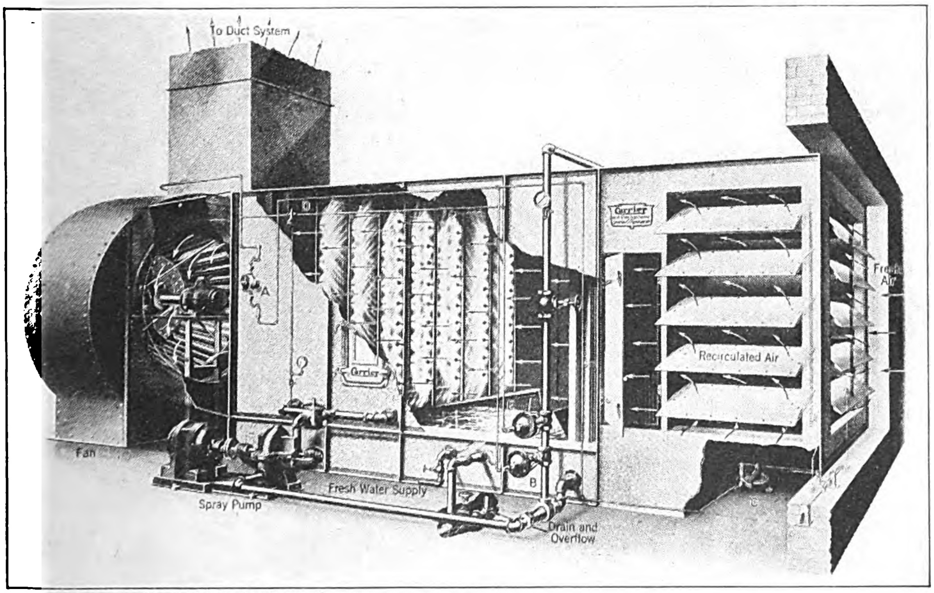
SPRAY WATER COOLER

A basement centrifugal refrigeration unit. This equipment cools the water supplied to spray chambers on the various floors



AN AIR CONDITIONER

There are 11 similar sets of this conditioning equipment, each supplying conditioned air to all offices on two floors



Photographs courtesy Carrier Engineering Corporation

TYPICAL CENTRAL STATION AIR CONDITIONING UNIT

The centrifugal fan at the left draws air through the automatically controlled dampers at the right, through the spray where it is washed, thence through eliminator plates to the ducts

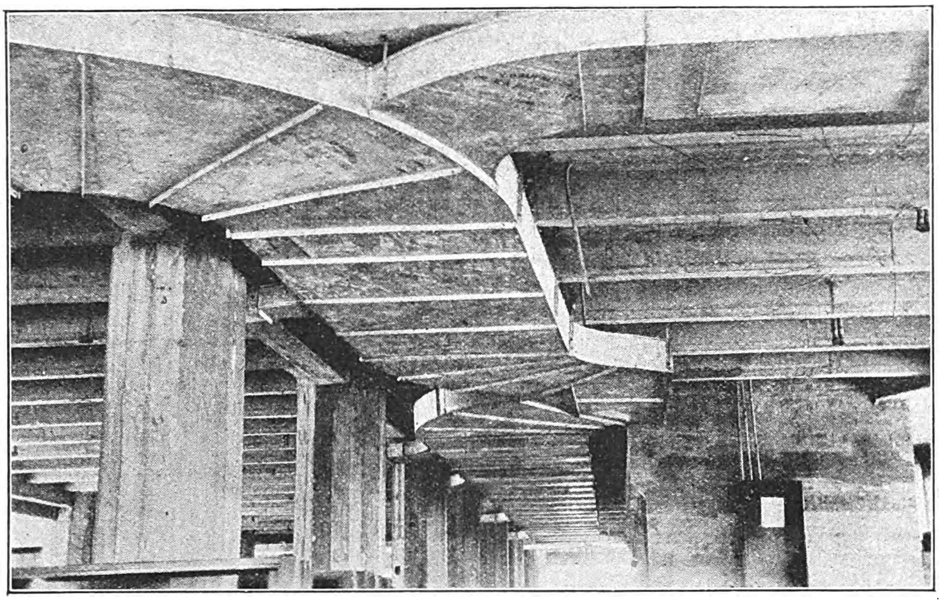
Water is forced through the weather plant at the rate of 1200 gallons per minute. The spray water is itself purified by recirculation, re-cooling, and settling, and is used over and over again.

It is the temperature of this spraying water that governs the "dew-point" temperature of the purified air. Two refrigerating units with a combined capacity of 375 tons of refrigerant per day regulate the temperature of this water. Thermostatic control maintains an even temperature of the water according to the setting of the equipment.

THE water in the spray chamber has a temperature of about 45 degrees. This spray in turn cools the air which passes through it, to a temperature about 10 degrees higher than that of the water.

This does not mean that the cleansed atmosphere is then driven into the various offices at this point. It has been found that the ideal temperature for air under the conditions of operation at San Antonio is about 78 to 80 degrees. So the washed air is brought back to over 70 degrees before being sent on its way to cool the offices of tenants in the Milam Building. The air must be introduced to the offices several degrees lower than the ultimate temperature desired. The heat of the return air is used for tempering the conditioned air wherever necessary. It is then ready to go to the various distributing units throughout the building.

A test shows that this washing process eliminates 95 percent of the dust found in the air at San Antonio. As an indication of the amount of dust and



CONDITIONED AIR DISTRIBUTION

The conditioned air is distributed to each individual office through a metal duct system. This illustration shows the duct system as it was installed during erection of the building

germs actually removed, dirt to the amount of seven bushels, on an average, is removed from the bottom of the water filter each week; and this is dirt which has been thrown into the clear city water by the incoming natural outside air.

Saturated cold air does not normally hold much moisture; and saturated over-warm air holds too much. By artifically lowering, then raising the temperature of the air which passes through this weather plant, the Milam Building not only maintains the proper temperature but the desired amount of moisture in the atmosphere as well. The air leaving the spray chamber is practically saturated.

If the fresh air entering the spray chamber from the outside of the building is excessively warm, as in the summer, the spray condenses this excess moisture as it lowers the temperature. If the natural air is cold as it comes into the spray chamber in the winter, it automatically absorbs the proper amount of water and the humidity remains at its ideal of 55 percent. Once the air is humidified or de-humidified, as the case may be, there is no opportunity for it to pick up more moisture.

The water for the sprays is cooled in the basement and delivered to the air conditioning units which are located on the upper floors, one unit generally serving two floors. There are two air conditioning units in the basement, one serving the cafeteria and one serving the stores on the first floor. There are, altogether, 11 sets of air conditioning equipment—the highest one being on the 18th floor—from which clean, properly cooled and properly de-humidified air is distributed to the offices on hot summer days for the comfort of office workers.

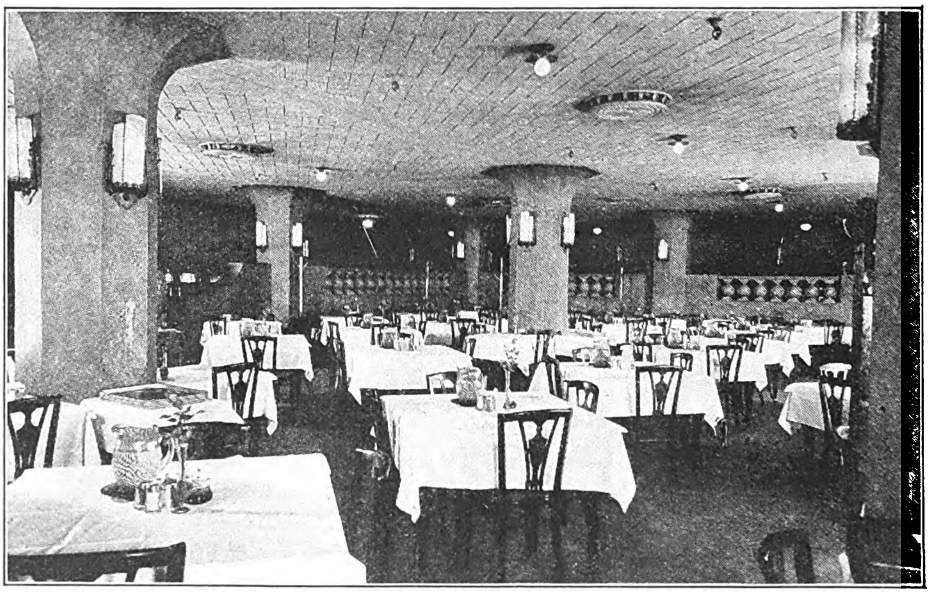
The air comes into a typical office through a grille in the wall near the ceiling. It is drawn out through a louvre in the lower panel of the door, carried through the corridors and gently swept, without creating a draught, by suction into pipes through which it is forced back to the plant, where it is mixed with incoming air, put through the weather plant and again purified.

There are dampers on the various distributing units which make it possible to regulate the volume of the air to compensate for the position of the sun during the day. During the summer, for example, the excessive heat on the east side of the building during the morning brings an abnormal amount of heat to offices on that side. By means of the volume damper an extra amount of cooled air goes to these offices to compensate. The amount is lessened at the same time on the west side, where the shade keeps the offices cool. The reverse is true in the afternoon.

Temperature may be regulated slightly over a range of several degrees in individual offices to suit the wants of the tenants. This is possible because of the adjustability of the grille through which the air enters the room.

Obviously, the window ventilation problems in the Milam Building are just the opposite of those in the usual office structure due to the characteristics of its air conditioning system. Here the problem is to keep out all natural air save that which comes through the weather plant. In the usual office, the problem is to make ample natural ventilation available through proper window openings. In this Texas building, windows serve no purpose save for natural lighting. As a matter of fact, they are made as nearly air-tight as it is humanly possible to make them. They have thick plate glass which runs length-wise. They are fitted into heavy steel casements and rest in frames cushioned with felt weather-strips one fourth of an inch thick.

Thus man-made weather, which has become familiar to many of us in the larger theaters and which has already been utilized in the manufacture of textiles, motion-picture film, flour, bakery products, candy, and other commodities, has now proved its value as an agent for promoting greater human efficiency among "white-collar" workers. With the steadily increasing use of manufactured weather equipment, it is not at all improbable that it will, in time, become standard for homes just the same as the furnace is at present.



AIRTIGHT BUT NOT AIRLESS

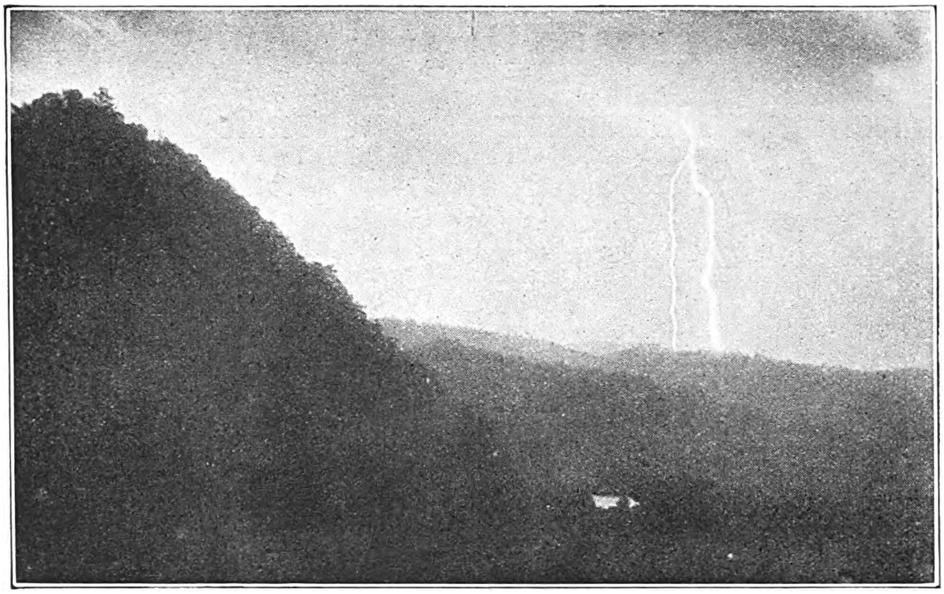
In the same manner that the offices are supplied with manufactured weather, this restaurant is kept comfortable at all seasons of the year. Note conditioned air inlets in the ceiling

Sky Photography *for* Lightning

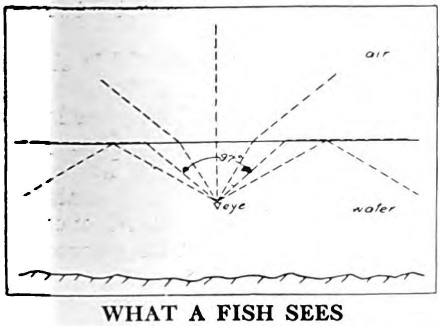
By ROBERT SPARKS[*]

PHOTOGRAPHS of lightning strokes have always proved valuable in any study of thunderstorm phenomena. The difficulty in photographing lightning, however, is that the flash may happen anywhere in the sky. Therefore, a camera, or cameras, must be provided which embrace the entire sky, or at least the entire horizon.

R. W. Wood, of the Westinghouse Electric and Manufacturing Company, had his attention called to the peculiar view presented to a fish in looking up into the air from the water. A beam of light shining on the water almost parallel with the surface is refracted to an angle of 48½ degrees from the vertical, and a beam coming at an angle between the horizon and the vertical is bent through intervening angles. Thus the fish sees the whole of the sky at once in an angle of about 97 degrees. As he looks more to one side, there is a total reflection and he can see the bottom of the pond. During a vacation by a lake in Maine, the writer took the opportunity to determine exactly how much a fish really could see. Upon swimming down into the water and looking up he found that the shore and a boat on the opposite side of the lake and the bottom of the lake on the shore side were all clearly visible at once.



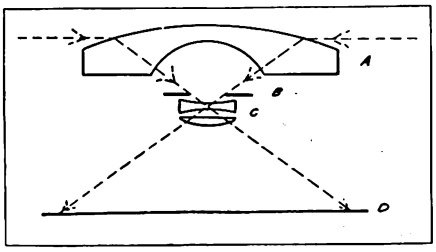
ENEMY OF POWER TRANSMISSION LINES
In the lightning investigation in the Tennessee mountains, photography of flashes is important. Photographic records, with other data, are expected to solve power-line problems



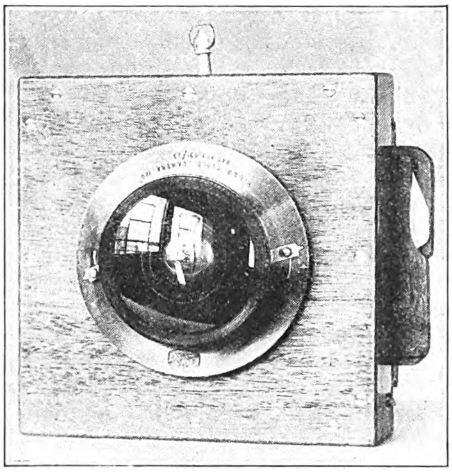
WHAT A FISH SEES
Looking up, the eye of the fish has the visual field indicated by the dotted lines

MR. Wood filled a pin-hole camera with water, and put a glass plate in front of the film to protect the film from the water. In this way he took pictures which he called "fish-eye" views. Mr. Wood's "fish-eye" camera was the first of its kind and while it was very interesting, it produced great distortion and was somewhat inconvenient to operate. W. N. Bond and Robin Hill independently made systems of glass spheres for lenses to produce a similar sort of picture. Mr. Hill later developed a lens giving equidistant projection.

One of our illustrations shows the lens system devised by Mr. Hill: "A" is the lens with a spherical surface which refracts the rays of light into a cone of about 90 degrees; "C" is a wide angle lens system giving a projection on the film "D"; at "B" is a provision for a color filter, since it is difficult to make a whole-sky system achromatic. With this projection, the photograph of a circle will appear as an ellipse toward the edge of the film, one diameter remaining always the same, the other lengthening.



HILL'S LENS SYSTEM
With this system, a 180-degree angle is covered. See text for full description



THE FISH-EYE CAMERA
When pointed to the zenith, this camera "takes" the sky from horizon to horizon

Whole-sky pictures taken with the Hill camera are very distorted near the edges. The camera has, however, the decided advantage that sections of a picture may be enlarged and corrected by reversing the action of the lens. This converts any section into a normal view as taken by the usual camera. The negative is mounted in the camera with a light behind it and the plate is placed in front of the camera. Thus for a normal view of a section near the horizon the plate is put at the desired distance and *parallel to the axis of the lens*. As a test of the accuracy of this method, a picture was taken by Hill of the columns in the nave of Ely Cathedral. A section of the distorted view, including one or two columns, was then enlarged and corrected by this method. The result was a normal, clear photograph with all the columns appearing straight.

In using this camera to photograph lightning, it is set up with the shutter open. It will then record on the negative a lightning stroke occurring anywhere in the heavens. After development, any section showing a flash may be enlarged and corrected into the sort of picture with which we are all familiar. It is, of course, easiest to obtain lightning pictures at night when the camera can be left open until after a stroke, but it is also possible to obtain lightning pictures during day storms when the clouds are heavy.

Two of these cameras may be used to take stereoscopic pictures. The two cameras may be set a quarter of a mile apart and the two exposures made at the same instant.

---

[*] Engineering Department, Westinghouse Electric and Manufacturing Company.

Estimating the Age of Writing*

Whether a Document Is Authentic May Usually be Discovered by Analysis of the Writing. In Legal Cases Such Methods Are Often Crucial

By C. AINSWORTH MITCHELL, M.A., F.I.C.
Secretary to the Society of Public Analysts

IT is often of the greatest importance to be able to form some opinion of the approximate age of the writing in a document. The question usually presents itself in one of two forms: Is the writing as old as it purports to be? or, Was the whole of the writing upon the document done at the same time—if not, which part was written first?

An answer to either question is possible only under certain conditions, which postulate a difference in the physical condition of the original pigments, or a chemical change in a pigment causing it to alter its original physical characteristics. In the absence of such original or eventual differences no opinion can be formed. For example, in the Seddon murder trial (1912) the accused produced a notebook as a proof that he had paid a weekly rental to his victim. The entries extended over a period of more than a year, and there was some reason to believe that the entire series of entries was spurious and written, not week by week, but all at one time. They had all been written with copying-ink (indelible) pencil, and the pigment was the same throughout the series.

BUT, except for the improbability that the same kind of copying-ink pencil should have been used weekly without a break, over so long a period, there were no data upon which any judgment could be based as to the relative ages of the first and last entries. This was inevitable because the pigments of copying-ink pencils consist of mixtures of graphite, aniline dye and China clay, and do not change when applied to paper, apart from some fading of the dyestuff after many years.

Ordinary writing ink, on the other hand, undergoes a progressive series of changes as the air acts upon it on the surface of the paper, and a study of these changes has enabled some approximate relationship to be established between them and the time that has elapsed since the ink was applied to the paper. The nature of the changes involved in the drying of ink can best be investigated by exposing freshly prepared ink to the air for long periods in open vessels, and separating and analysing the insoluble films which successively form upon the surface. When first made by mixing an infusion of galls or other source of tannin with copperas (ferrous sulfate), ink consists essentially of a nearly colorless solution of ferrous tannate. When this liquid is exposed to the air it slowly darkens and is oxidized progressively to a series of iron tannates. The first of these forming a film on the surface of the liquid contains 5.53 percent of iron and is readily soluble in very dilute acid, but is not quite insoluble in water. Hence, writing freshly applied to the paper will yield a copy for a day or so when pressed on to moist absorbent paper.

As the oxidation of the ink proceeds, a second iron tannate containing 8.1 percent of iron is formed. This is resinous in character, is quite insoluble in water, and is much more difficult to dissolve in dilute acids. It also envelops within itself the particles of any soluble dye present in the ink, and to a large extent prevents smudging when the writing is treated with dilute reagents. This stage requires at least two or three years before it is complete, and it is on the distinctive differences between the two tannates that chemical tests for the age of ink in writing depend, although, as recent work has shown, the mixtures of the tannates are of variable composition and may contain absorbed tannin.

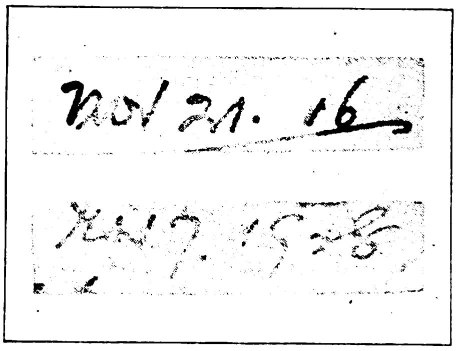


FIGURE 1
Treatment with a bleaching agent or dilute acid serves to reveal the age of writing

The change of color in ink on paper takes place very rapidly at first, but after a day or two the rate of alteration slows down, although the final stage of darkness is not reached, under the usual conditions of protection from light, until after the lapse of many months. The change in the color of the ink can be followed and recorded by the use of a combination of the tintometer and microscope. The principle of the tintometer is the matching of a color with a standardized series of red, blue, and yellow glasses, which, when superposed, transmit light to enable a record to be taken of any color. Osborn's comparison microscope has been adapted for use with the Lovibond tintometer glasses. This microscope has two tubes, each having its own objective and with their upper ends fitted with a prism box by means of which the images seen through the two objectives are brought into juxtaposition beneath a single eyepiece. In using this instrument for the examination of ink in writing, one of the tubes is focused over the writing, while the standard Lovibond glasses are placed in a slot in the other tube, and a record is taken of the glasses required to match the color of the ink.

FOR example, a blue-black ink freshly applied to the paper gave a reading of three blue units on the Lovibond scale, but after an hour or two red and yellow units also appeared, and after ten months the color was matched by blue, 3.5, red, 9.7, and yellow, 0.2 units. Commercial iron-gall inks usually contain an added aniline dye to give color to the writing pending the formation of the dark iron tannates, and the well-known color changes that occur when such an ink dries on paper are the result of the gradual masking of the blue dye by the progressively darkening series of iron tannates.

It is obvious that such a record of the color of an ink may afford valuable information as to the age of writing, but by way of illustration an actual instance, within the last twelve months, may be cited.

A tradesman had insured his stock of textile materials with a London insurance company, and some time later was the victim of a fire which destroyed his shop. As a proof of what had been lost he produced a notebook containing lists of goods purchased over a period of two years. The insurance company doubted the genuineness of these lists, which they had grounds for believing had been compiled soon after the fire. Colorimetric tests applied to the writing confirmed this suspicion, for the ink in the writing in the beginning of the lists (as well as that at the end) changed its color after the lapse of a few days, and therefore could not have been two years old. The insurance company did not pay the claim, and the case did not come into court.

---

* Reprinted, by permission, from *Discovery* (London).

The formation in writing of the resinous tannate mentioned above is indicated chemically by the behaviour of the ink on treatment with dilute acids or bleaching agents. If, for instance, writing in blue-black ink freshly applied to the paper is treated with two percent hydrochloric acid, it will rapidly smudge and the blue dye will "run," but if the writing is some years old the ink will resist the reagent, and the blue dye will not be dissolved (see Figure 1).

THE first occasion on which evidence based on this chemical method was given in a court of law was in 1911 at the trial of Colonel Pilcher, who was accused of forging his cousin's will. This document purported to have been signed twelve years before the date of the trial, and both of the alleged witnesses to it were dead. On treating various parts of the will with dilute reagents all the ink in the body of the will, and each of the signatures, rapidly ran and the blue dye made smudges over the surface of the paper. Tests applied in the same way and under parallel conditions to the counterfoils (stubs) of check books of the alleged testatrix caused rapid smudging in those only one or two years old, but had hardly any action on those three or four years old, and practically no effect on the writing five or six years old. Evidence to this effect was given at the trial to prove that the writing upon the will could not have been twelve years old. Ultimately Colonel Pilcher confessed that he had uttered the will knowing it to be a forgery, and was sentenced to three years' penal servitude.

If some of the ink upon a document, the whole of which purports to have been written at the same time, is found to be of a different kind from the rest of the ink, it naturally raises a suspicion that a later addition has been made to the document. The methods of determining this may be photographic or chemical. A good illustration of this kind of test is afforded by the case of *Rex v. Cornwallis* (1921), in which a woman was tried on the charge of forgery. She had received a letter acknowledging the receipt of £200, but claimed that the actual amount was £2,000 (see Figure 2). To the naked eye the final "o" appeared closely similar to the rest of the amount, but it happened to be in an ink containing less blue dye, and therefore affected a photographic plate very differently, as is obvious in the illustration. The accused woman was convicted of the forgery and sentenced to a term of imprisonment.

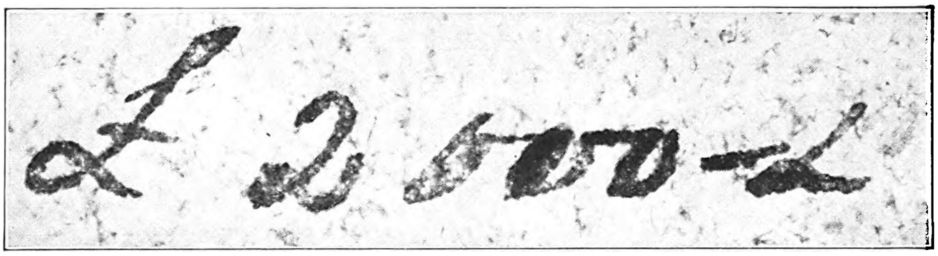


FIGURE 2

The figure 200 was raised to 2000, as revealed in the chemical laboratory

But a difference in ink may not always be conclusive of fraud, for the ink itself may produce variations in the writing. This was shown in the Howes will case (*Skelton v. Howes*, 1924), in which a will was found six months after the death of the testator, and appeared suspicious owing to the signatures having been retouched and some of the ink showing a difference of color.

AT the request of the judge I was called in to investigate the will, and found that the abnormalities in the ink were due to three bottles of ink, bought at a sale, having been mixed together, so that the appearance of the ink depended upon the depth to which the pen was dipped into the mixture. The ink also left the pen rapidly and this explained the necessity for retouching some of the signatures.

Conclusive evidence as to the priority of two pieces of writing is sometimes furnished by the fact that one stroke has happened to overlap another, and that it may be possible to see which stroke is uppermost and therefore the more recent. But the test is not quite as simple as might appear, as has recently been shown by Ward and the writer (*Analyst*, 52, 582).

If two strokes are made to intersect at the time of writing it is quite impossible to decide which was made first, for the ink in the two strokes mingles and the insoluble tannate forms simultaneously in each. If, however, a few hours are allowed to elapse between the making of the first and second strokes it may be possible to decide which is uppermost, although one cannot be certain that mingling of the two strokes will not occur, until after about 48 hours' interval between the strokes. Blotting renders the judgment uncertain, especially if the blotted line is uppermost, although when the first line has been blotted and the second has not, it is usually possible to see distinctly that the insoluble pigment is above the first stroke.

A series of systematic experiments (Figure 3) extending over two years has shown that in all cases the possibility of deciding which of two intersecting lines is on top depends upon the physical condition of the two pigments; if one of them is transparent, as in the case of the dye in colored writing inks or in certain typing inks, the differentiation of the sequence of the strokes is uncertain. If, however, the conditions necessary for the formation of an opaque pigment in the uppermost line are present, there can be no doubt that the line which appears to be on top really is uppermost.

THE remarkable value of the method was shown by a case heard in the Probate Court in 1924. A testator had added a codicil to his will, which altered its tenor. A few strokes in the writing of this codicil intersected strokes in the signature, and microscopical examination showed that the codicil had been written after the original will was signed. The latter was therefore ordered to stand.

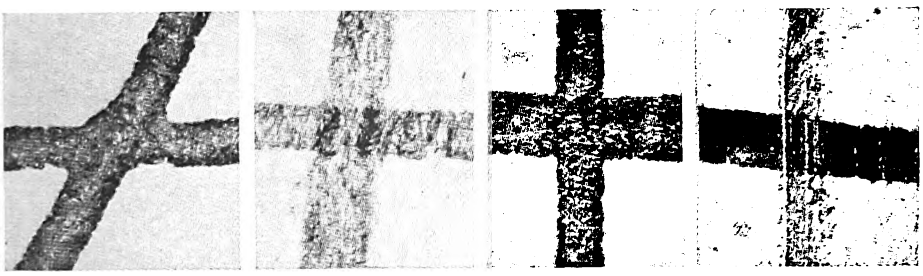


FIGURE 3

Left to right: Logwood ink strokes crossed immediately. Blue-black ink, on blue-black ink, blotted. Same inks, 48 hours between strokes. Lead pencil on black ink. All ×13

¶ *When you stop to think of it, the ordinary clothing a man wears is a fit candidate for a thorough revision. Hot, stuffy, stiff, costly, inefficient—no scientist, no engineer, would tolerate a comparably crude arrangement of equipment. On this, next month, there will be an article.*

Earth Shine

From the Moon the Earth Would Appear Many Times as Bright as the Moon Appears from the Earth. Interesting New Research on an Old Subject

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

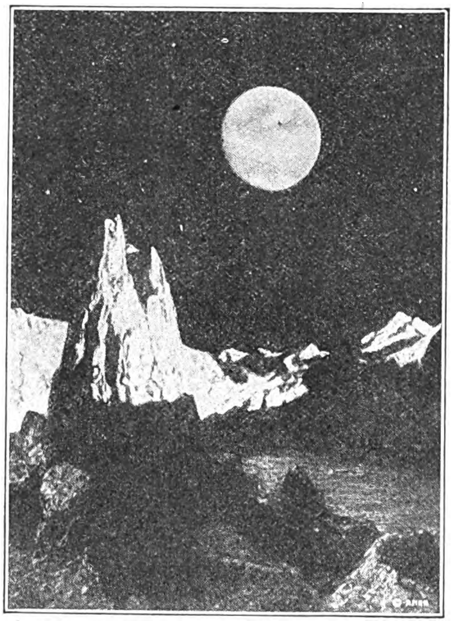
WITH so many observatories scattered over the world, and so many astronomers at work in them, it might be imagined that everything which can be seen directly with the eye had long ago been observed to the "saturation point." It is true that much of the work of the present is done with powerful instruments upon bodies quite invisible to the naked eye, but now and again some good piece of work is done with small instruments upon familiar objects.

An excellent instance comes from the Observatory of Strasbourg where a young French astronomer named Danjon has been doing photometric work of notable interest. Much of this has been accomplished with a new instrument of his own invention which he calls the "cat's eye photometer." In this ingenious device the light of one star, coming through the main part of the objective of a telescope, is compared with that of a brighter star which has passed through a small square of adjustable size (the "cat's eye"), and then by reflection into the telescope. By adjusting the size of the aperture the two images are made to appear equally bright.

THE first instrument to be constructed had a telescope only three inches in aperture and two feet long, but a long series of observations upon Algol showed that it gives results of remarkable precision. All the characteristics of the star's variation, including the small secondary minimum due to the eclipse of the faint companion by the bright star, are clearly shown.

Having then demonstrated the value of his new instrument, Monsieur Danjon has applied it to the study of something which has been known for centuries but has never before been accurately measured. Everybody has seen "the old moon in the new moon's arms." When the crescent, whether waxing or waning, is visible in a clear, dark sky, the outline of the rest of the moon's disk is clearly perceptible. With a field glass (or with the naked eye under the best conditions) the familiar dark spots may even be seen upon the faintly lighted surface. Almost everyone knows, too, that the faint illumination arises from sunlight reflected by the earth to the moon—"earth light" on the moon—exactly similar in nature to moonlight on the earth but brighter. When the bright sunlit crescent is there, the "earth shine" is easy to see, but for a half moon it is barely visible. There are two reasons for this: the half moon is brighter, and its light drowns the earth shine out; and at the same time an observer on the moon would see only a "half earth" instead of a nearly full earth, and the earth shine would obviously be fainter.

From measures of the brightness of the earth shine it should be possible to determine how much light the earth reflects, and also how the amount of reflected light falls off with changes in the earth's phase. But although the earth shine is easy enough to see, it is very difficult to measure. It is faint and badly mixed up with the light of the sky—that is, with ordinary moonlight scattered by the earth's atmosphere. Moreover, the moon's surface is spotted and of very irregular brightness.



Copyright American Museum of Natural History

LUNAR LANDSCAPE

Painted by Howard Russell Butler, N. A.
The earth's tropics are shrouded by clouds

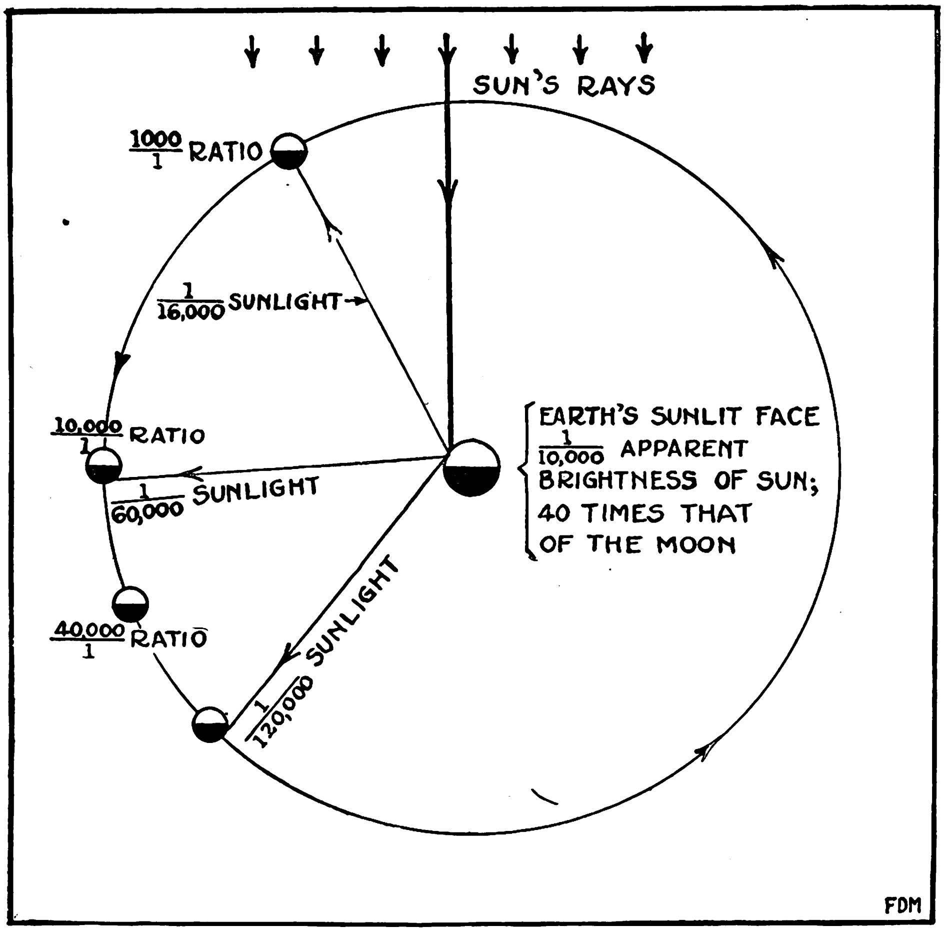
Several observers have attacked the problem, the first being the late Professor F. W. Very. Their results agree in showing that the earth reflected about half the light which fell upon it, but were not precise enough to show the changes with phase. Monsieur Danjon proceeds by comparing the earth shine as received directly with his three-inch telescope with an image of the bright part of the moon cut down by his "cat's eye" and further weakened by reflection from unsilvered glass surfaces; and his results are of quite a different order of accuracy than anything which has preceded them. Since the images of the bright moon and the earth shine are visible in the same field and on the same background, the troublesome correction for the latter is almost abolished; and since the whole surface of the moon is in sight it is possible to make allowances and to compare the average brightness of the sunlit and earthlit portions.

MEASURES on more than 50 nights show very clearly that the earth shine wanes rapidly as the moon waxes. When the moon is a thin crescent about 30 degrees from the sun (see sketch, upper position) the earth shine is about one thousandth as bright as an equally large portion of the sunlit crescent; at the half moon (second position, in sketch) it is less than one ten-thousandth as bright; and when the moon is 120 degrees from the sun (third position, in sketch) the earth shine has sunk to one forty-thousandth of the brightness of the rest of the disk and can be followed no longer.

To find from these measures what is the real brightness of the earth shine *falling on* the moon takes a bit of calculation. The average brightness of the sunlit part of the earth's surface is not always the same, but falls off rapidly from the full phase (when it is greatest) toward the quarters. This happens partly because the sun's rays strike it more obliquely, but still more because the moon's surface is very rough. At the time of full moon every mountain, and for that matter every loose rock, hides its own shadow from us. But as the moon departs from the full the shadows come out more and more. The average apparent brightness of the visible surface is thus reduced at the half moon to only one fifth of that of the full moon; while for the crescent 30 degrees from the sun the brightness is only one twenty-fifth of that which would be shown by a "shaving" of the full moon of the same apparent width.

This effect is remarkably great and it has long been realized that it shows that the moon's surface must be exceedingly rough. The shadows of the visible mountains would suffice to account for but a small part of the observed change, and it is probable that the greater part of the moon's surface is either covered with loose material like the rock piles at the foot of a cliff or is tumultuously rough like the hardened surface of a lava flow. Both of these hypotheses are obviously consistent with what we know otherwise about the lunar surface.

Making allowance for this, Danjon calculates the ratio of the brightness of the earth shine to that of the full moon, which is obviously the ratio of the brightness of sunlight and earth light as seen by an observer *on the moon's surface.* When the moon is 30 degrees from the sun the earth, which would then show almost the full phase to a lunar observer, lights up the moon's dark surface about one sixteen-thousandth as strongly as the sun does.



APPARENT *VERSUS* REAL BRIGHTNESS OF EARTH SHINE

The apparent brightness of earth shine on the moon is not a measure of the amount of light impinging on it's surface; the former takes account of the amount of light reflected back to the instrument or eye on the earth; the latter only of the light received on the moon

At the half moon and half earth this fraction has decreased to one sixty-thousandth, while the terrestrial crescent, when reduced to half the width of the half phase, would give but one one-hundred and twenty thousandth of the sun's light. From a plot of these data a reasonably safe extrapolation can be made over the relatively short interval back to the full earth, which is thus found for a lunar observer to be one ten-thousandth as bright as the sun. This is more than 40 times as bright as the moon appears to us at the same distance. The earth is of course much bigger, but this would account for only a fourteen-fold difference. The excess indicates that the earth's surface is a much better reflector of light than the moon's.

Qualitatively this was certain in advance of any measures, for the earth is largely covered with clouds; and even when it is not, its atmosphere would reflect about as much light upward into space as it sends down to the surface to form the blue sky. Compared with these the light reflected from the land and water surface is doubtless of minor amount but the moon has no atmosphere and a surface of bare rocks. A difference in the observed direction was to be expected and the observed amount, which makes the earth as a whole three times higher in reflecting power than the moon, is also reasonable.

One might expect, too, that the earth light would be bluer than the moonlight, or even than sunlight; since clouds are white and the sky is blue. Danjon has tested this by making observations on expecially fine nights through red and green color screens. Four evenings' work agreed closely in showing that, observed in green light, the earth shine is one third brighter compared with the crescent than when seeing with red light. Observations in blue light, which would have doubtless shown a still greater difference, are not practicable owing to the faintness of the earth shine.

Between the full phase and the half phase the light reflected by the earth drops to one sixth of its value, as against one tenth for the moon. It follows that the surface of the earth is not as rough as the moon's. This was again to be expected; at first sight, indeed, one might have anticipated a still greater discrepancy in the two cases.

The light of the blue sky and that reflected from smooth layers of cloud or fog might be expected to show a smaller loss at half phase. Very vivid memories of cloud surfaces seen from below from an airplane suggest to the writer that the roughness of the earth's reflecting surface is mainly that of the tumbled upper face of the broken clouds, and clouds act as efficient reflectors.

To determine the albedo of the earth (that is the fraction of all the sunlight falling upon it which is reflected away again) it is necessary to take an average for all phases. The result comes out to be 29 percent, which is smaller than has previously been calculated from the known cloudiness of the earth. The exact value of this figure depends on the precision of the large corrections which have to be made for the action of the devices which have to be adopted in the photometer to weaken the direct image of the crescent so as to make it comparable with the earth shine; but Danjon's value is nevertheless very much better than any previous determinations by observation.

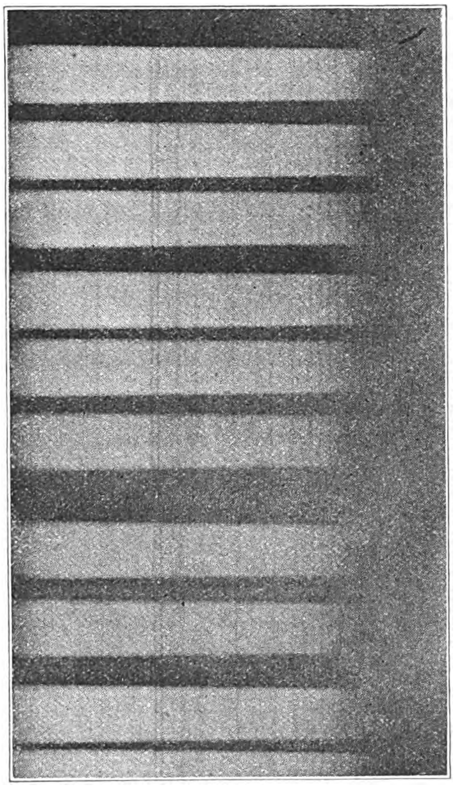
It may finally be remarked that the moon at the time of a total solar eclipse is illuminated by a full earth, the loss owing to the moon's shadow on the latter being small. It should therefore be somewhat brighter than the earth shine is at any other time. Danjon's data make its stellar magnitude minus 2.5, more than twice as bright as Sirius and brighter than Jupiter. During an eclipse, of course, the moon is seen against the background of the corona, which is many thousand times brighter than this, and it therefore looks black. It might be interesting, however, when the moon is thin to compare the earth shine directly with an out-of-focus image of a bright star that looks to be about the same size.

The Ultra-Violet From the Sun

A Ridiculously Small Quantity of Ozone in the Atmosphere Controls the Amount of Ultra-Violet Which Reaches the Earth's Surface

By RICHARD RUEDY, D. Sc.
Research Physicist

SUNLIGHT, when it is passing through a wedge of glass, gives the well-known rainbow colors—a band of red, yellow, green, blue, and violet. That is as far as the eye sees it. But there are other "colors," invisible to the eye, at both ends of the band or spectrum. If upon a screen, we should mark off the point where the violet ends, and photograph the spectrum, the plate would show an extension beyond the violet, because the plate or film is sensitive to a greater range of "colors" than the eye.



SPECTRUM OF SUN

Figure 1: Spectrograms made at equal intervals during last hour before sunset (note space), and early after sunrise the next morning. Here, as on page 34, the short wavelengths are shown at the right

The sun's spectrum is not quite uniform and its end is not quite sharp, at least not when produced by a good wedge or prism of glass, or better, of quartz. (See Figure 1). There are dark and bright bands in the ultra-violet region, and the extent and darkness of the bands change with the hours of the day. Nor is the end of the spectrum always at the same point. As the sun rises higher and higher during the first morning hours, the spectrum extends farther and farther into the invisible region.

As the sun sets, the reverse change takes place, the dark bands, which were scarcely noticeable at noon, become sharper and sharper and cut off more and more of the ultra-violet light. The light from the sun has at that hour and after sunrise a much longer path to travel through the atmosphere than at noon, and if the air were not quite transparent to ultra-violet radiation, it would be easy to understand why the ultra-violet is weakened in the evening and in the morning.

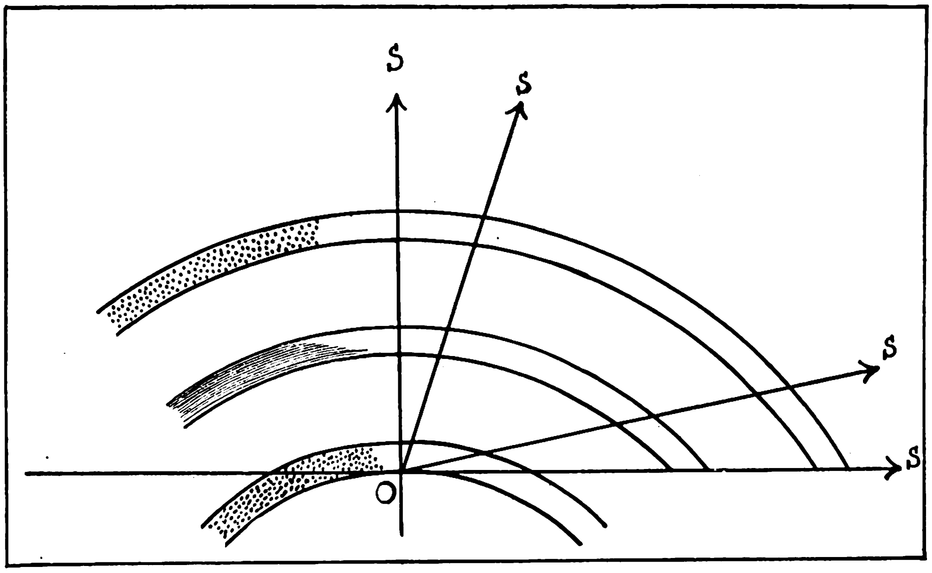
An accurate study shows, however, that the ultra-violet which reaches us varies often from day to day, for the same position of the sun, and sometimes from hour to hour. Air alone could not cause such a variation.

As a matter of fact, air is transparent to these radiations at the "end" of the spectrum and lets them pass freely. Beams of ultra-violet from a carbon arc are often sent over distances at the surface of the earth where they have to pass across more air than would correspond to the entire height of the atmosphere, and afterwards they are not much weaker than those of other colors. The snow-clad mountain tops are visible over large distances, sending the sun's light through a mass of air many times thicker than the atmosphere above, and what ultra-violet light reaches them from the sun and is reflected horizontally gets through.

There must then exist a substance higher up in the atmosphere to account for the stopping of the far end of the spectrum.

It is even possible to determine the altitude of the absorbing layer, because the surface of the earth is curved. As Figure 2 shows, if a bank of more or less opaque material is assumed to be at different altitudes, the path of the sun's rays will vary in all of them with the height of the sun. Around noon, the variation is nearly the same whether the bank is at 0 or 50 or 100 miles above the earth's surface. The path depends only upon the direction in which the sun appears. But towards evening, the path will become the longer the lower the altitude of the layer.

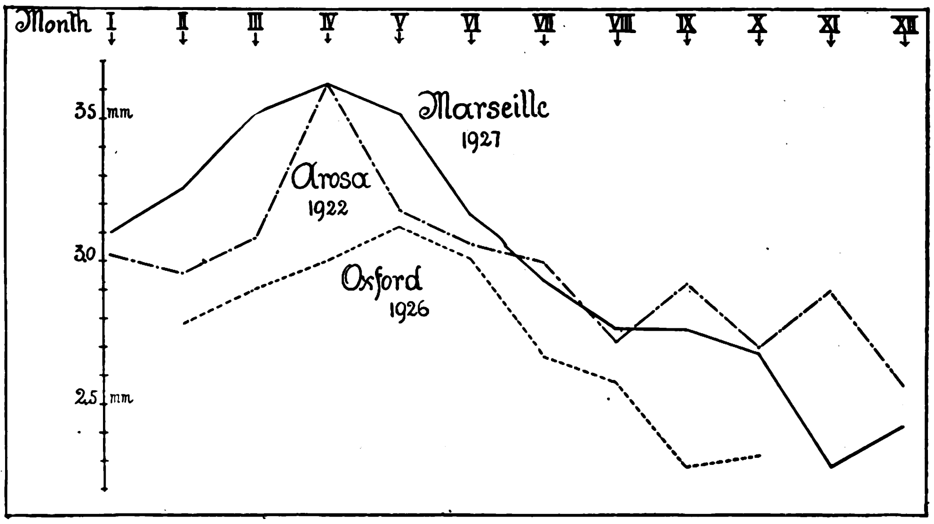
BY studying how fast the ultra-violet gets dimmer in the evening and morning hours, it is possible, as Professor Fabry has pointed out, to find by trial or by calculation which altitude will account best for the observed intensity change. Up to the present moment such measurements have only been made in three places: in Montpelier, southern France (1926); in Arosa, Switzerland; and at Toronto (1927). In all three places the average



EFFECT OF THE ALTITUDE OF THE OZONE

Figure 2: The lower the layer the greater is the variation in length of path of the sunlight from noon to evening. This permits determination of the altitude of the absorbing layer

altitude of the layer was found to be in the neighborhood of 40 kilometers (25 miles). At that altitude the pressure is low, not much more than 1/1000 of the pressure at the earth's surface.



VARIATION OF OZONE THROUGHOUT THE YEAR

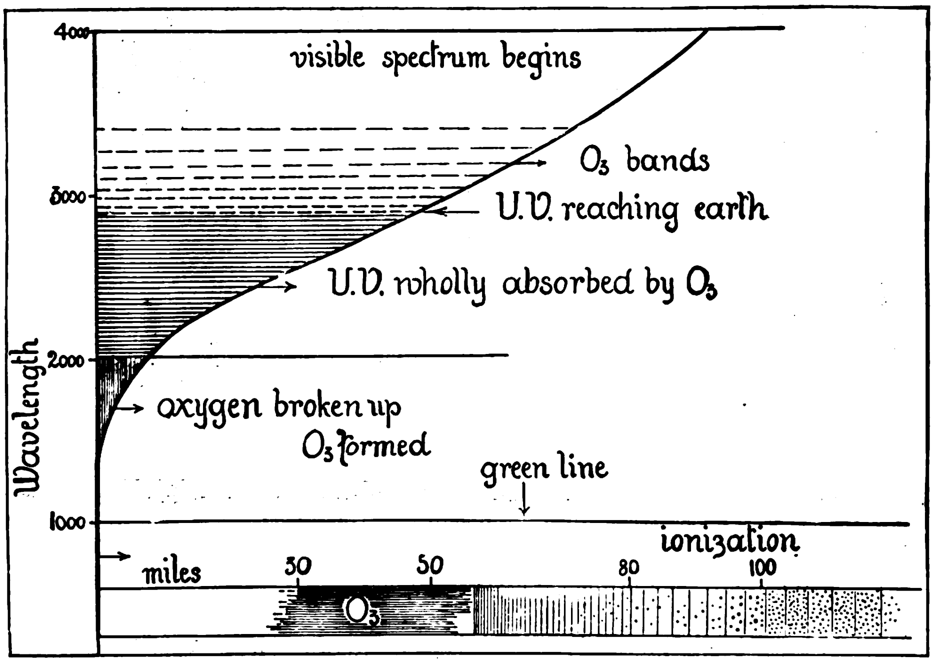
Figure 3: In Marseilles, southern France, it proved possible to make spectroscopic determinations on almost every day of the year. Similar variations have been observed at Mount Wilson Observatory, California. The ozone "burns away" as summer advances

At such an altitude there might exist a gas lighter than oxygen and nitrogen. This, however, proved not to be the case. Raleigh and Fowler, experimenting some time ago with ozone, found that the same dark bands appear as in the sun's spectrum, if the ultra-violet light from an arc is sent through a mixture of ozone and oxygen.

Now ozone is a gas heavier than air; it is a form of concentrated oxygen, "150 percent oxygen," so to speak. It is a peculiar substance, only quite recently obtained in a pure form, explosive when concentrated, of dark blue-black color when liquefied and transformed back to ordinary oxygen when slowly heated. Its occurrence in the high atmosphere explains not only the dark bands in the ultra-violet spectrum, it accounts also for the abrupt end of the sun's spectrum.

CERTAINLY the sun itself sends out more ultra-violet light and a much longer colorband than we observe on earth; but the ozone, as if it were a piece of metal, screens off the farther end. We may measure how much ultra-violet is absorbed by a layer of ozone of one or two or five millimeter thickness, and by studying the bright and the dark bands in the spectrum (Figure 1), we may compare this with the amount that the atmosphere absorbs. The result is that there must be, at about 40 kilometers (25 miles) altitude, a layer of ozone equivalent to three millimeters or one eighth of an inch at atmospheric pressure. This is a small amount, and ozone is one of the rarest gases of the atmosphere.

The number of waves of ultra-violet light from the sun which the atmosphere lets through is comparatively small—less than 1 percent of the whole energy—but these waves at the end of the spectrum are in many respects more powerful than the visible ones. They are the rays under which wounds begin to heal, pale cheeks to color. Or, as an English farmer has recently put it, "They are the rays which bring higher market prices for pigs." Even if it were only for the amount of heat which the earth loses by the absorption of these rays in the atmosphere they would represent a sum of almost 1,000,000 dollars per second. No wonder therefore that in the last few years accurate measurements on the ozone bands have been made, and in some places the quantity of ozone (or of ultra-violet) had been followed from day to day.



DISTRIBUTION OF ENERGY IN SUN'S ULTRA-VIOLET

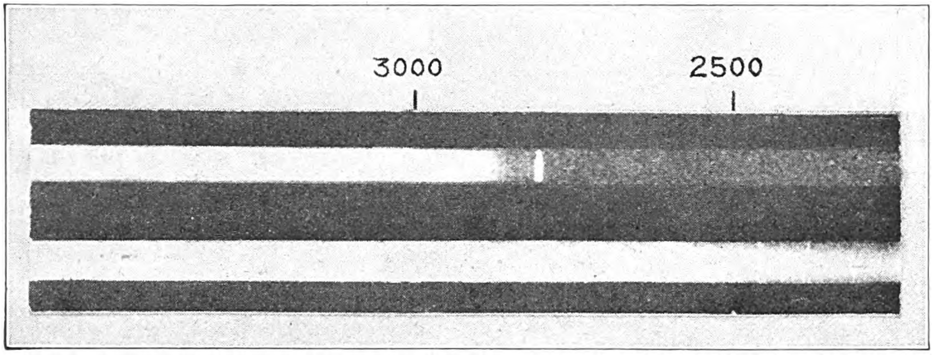
Figure 4: Height above the earth is shown on horizontal scale. Vertical scale gives wavelengths in Angstrom units (A.U.) in the ultra-violet. Wavelengths below 2960 A.U. issue from the sun but do not reach the ground level as longer ones do. At 3900 A.U. the ultra-violet ends and the visible spectrum begins. The distance from left side to the curve represents relative amount of energy which the sun emits at the wavelength chosen. The entire figure shows effect of ultra-violet upon the atmosphere, and is worthy of detailed study

The ultra-violet spectrum has been and is being studied in Arosa, Switzerland, at the expense of this famous mountain resort; in the Meteorological Department of Oxford University, England; at the University of Montpelier, France, where the sky is very clear, and many other localities. Other places carry out some work on the total absorption of ultra-violet only. The first years of study have already given some interesting results. In all the places situated in the northern hemisphere there is a marked variation in the course of the year of the amount of ozone present. The thickness of the layer is highest in the beginning of spring and decreases during the summer months, (Figure 3).

TOWARD autumn the atmosphere becomes clearer for the ultra-violet. Probably, as the summer heat increases, the ozone begins to decompose faster than it is formed, as heat has been found to be detrimental to its existence. Another feature is that the altitude varies in the course of the year.

Finally, the amount of ultra-violet varies from place to place, a maximum having been found in Egypt. It will be necessary, however, to make further observations and it is greatly to be desired that more stations should collaborate in different parts of the globe. In Toronto, where I have made a series of observations, the winter months are too cloudy for useful observations.

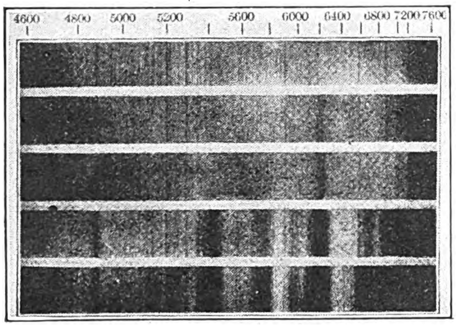
How is ozone formed in the atmosphere? In the laboratory ozone may be



SHOWING HOW OZONE CUTS OFF THE SHORT ULTRA-VIOLET

These two spectrograms of an electric arc were taken through a quartz prism, as glass would exclude the shorter wavelengths of the ultra-violet. In the lower one wavelengths as short as 2200 Angstrom units—much shorter than any in sunlight—are indicated. In the upper one ozone was introduced. It cut off the majority of the shorter wavelengths

prepared in very different ways. Ozone is formed when an electric discharge is sent through oxygen, and is used in this way for the sterilization of drinking water. In the atmosphere we have discharges in the form of the Northern Lights, causing irregular variations, but it is not known how far their influence extends toward the south. Ozone is also formed when ultra-violet light from a mercury arc or from a spark is sent through oxygen, and part of the action of the ultra-violet may actually be due to ozone. In the high atmosphere there is available the ultra-violet radiation from the sun. Although its energy is small, less than 1 percent of the total solar energy stream, this limited part of the solar spectrum brings about more effects in the atmosphere than perhaps the whole remaining portion, (Figure 4).



UNKNOWN DARK BANDS

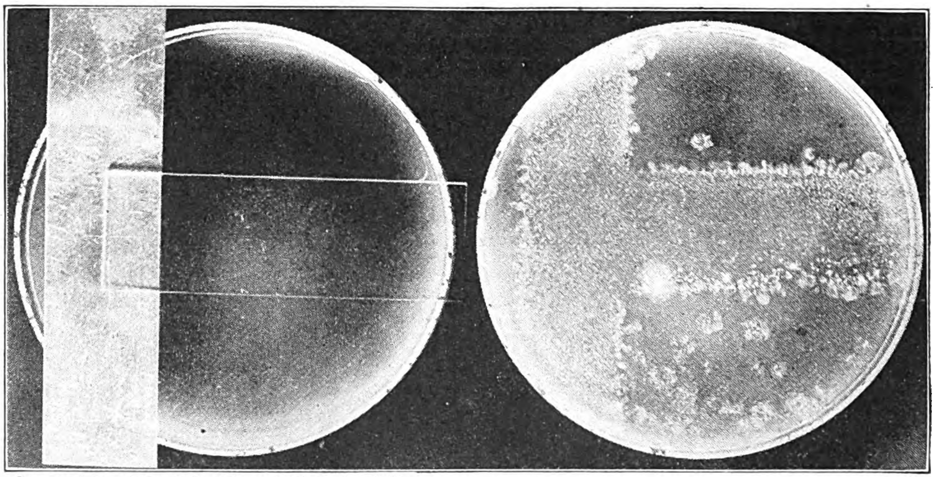
Spectrograms of light reflected from the planets (top to bottom, moon, Jupiter, Saturn, Mars, Neptune) made at Lowell Observatory by Slipher. The moon's is simply reflected sunlight, as the moon has no atmosphere. The minor planets give a similar spectrum, but the other planets hold back narrow bands of light, particularly in the infra-red (off the scale, to right) and in the visible spectrum (7700 to 3900 A.U.). The only substance known which shows the same absorption in the visible spectrum is *ozone*. Note absorption bands near 5400, 5750, 6100, 6200

The farthest end of the spectrum ionizes the air, that is, breaks up the air into positively or negatively charged particles. A conducting layer is formed which reflects and bends radio waves. The next portion of light waves breaks up the oxygen, or better, breaks up one part of the ordinary molecular oxygen into two parts of atomic and more active oxygen, some of it being perhaps phosphorescent or made phosphorescent by the ultra-violet light. This region, extending from about 50 miles altitude to 120 miles or more, sends out a faint green light during the night. Not before 1925 was the same kind of light produced on earth (see "The Mystery of the Green Line," McLennan, SCIENTIFIC AMERICAN, January, 1929), and in 1927 I was able to show that this peculiar light was a quite unusual "forbidden" ray, which can be sent out when chemical reactions take place in a diluted gas.

Toward the lower altitudes of 30 and 40 miles, oxygen atoms become scarce, and when they come in close contact with the oxygen molecules, ozone or O_3, really an oxygen triplet, may be formed. The total number of ultra-violet waves which are able to split up the molecular oxygen is limited, so that a measurable increase or decrease in ozone requires a fairly long time. It would take a day to double the amount of ozone in the air.

The ozone bank at 30 miles altitude absorbs a considerable portion of ultra-violet (Figure 4), especially that part of it beyond the spectrum of natural sunlight which has proved injurious to our body and harmful to the life of plants. Its only action is now to heat up the ozone which keeps it back. Thus a warm layer of air is formed high up in the atmosphere, which helps to support the heavier ozone molecules. Thus we find that the dark and bright bands in the sun's ultra-violet are the same as those observed with ozone in the laboratory. If the temperature of the ozone layer were to become very low, the bands would be much narrower. The smallest portion of the powerful ultra-violet radiation penetrates down to the earth to our greatest benefit.

ON the moon or on planets which lack oxygen, the surface is exposed to the entire ultra-violet, even to the harmful short rays which exert their destructive action freely. On the major planets, on the other hand, where oxygen and water seem abundant, ozone will again be formed, and as the temperature is low enough it will perhaps even condense. The spectra of these planets have new dark bands in the green, in regions where the visible ozone absorption is strongest. The significance of this is evident.



Courtesy of Journal of Agricultural Research (Washington, D.C.)

CAN ULTRA-VIOLET RAYS DESTROY DISEASE GERMS IN OUR BODIES?

This experiment demonstrates the extremely low penetrative power of ultra-violet rays. At left is a dish containing invisible cultures of microscopic fungi that attack citrus fruits. Over the dish a strip of metal and a piece of glass have been laid and the whole exposed to strong ultra-violet rays from a special lamp. Then the dish was put away for the invisible cultures to multiply and become visible. Three days later we have the picture at the right. The metal strip obviously protected the cultures for they are now thriving and visible where it was. The thin glass shut off the destructive ultra-violet rays about as well as the metal. Elsewhere there are occasional patches of cultures which were not killed, merely because the tiny spores were able to screen off the spores lying beneath them—so non-penetrative are the ultra-violet rays. From research performed by Harry R. Fulton (Bureau of Plant Industry) and W. W. Coblentz (Bureau of Standards). If ultra-violet rays are stopped by a tiny spore, or even a bacterium, what becomes of claims that certain ultra-violet lamps can "destroy disease germs" within the body, merely because ultra-violet rays do destroy germs—if they strike them? It is true, a patient's blood may acquire added power to kill germs, as a result of effects picked up by it from the skin after exposure to ultra-violet rays, but this power may actually be reduced to less than normal by over-exposure. Thus the correct exposure for each patient is a difficult matter for the specialist to arrive at—not to speak of the layman. (This illustration is inserted by the editor.)

It Is Safe to Fly

High Safety Factors in Construction, and Efficient Personnel, Contribute Materially to Aviation Advancement

By LADY MARY HEATH

LIFE has become such a rush—there is so much to be done and crowded into each day's 24 hours—that we have become a nation of headline readers. Herein lies a tragedy. We see a headline, "Another Air Crash," and instead of reading through the story, we instantly put the accident at the door of general aviation. We fail to realize that accidents most often occur in experimental flights, in stunt flights, or perhaps because some carefree pilot has been practicing the arts of warfare in a high-powered machine. Even in the military service, where one would expect most of the flying accidents, they are getting fewer and fewer. For example, there have been one third less army accidents in the past year than during the two previous years.

THERE are three main factors in aviation today: ease, economy, and safety. The ease of flying is shown by the wonderful record of the British light airplane clubs which graduate hundreds of pilots, men and women, with an insured minimum of 10 hours instruction. In the first half of 1928, these pilots made 45,000 flights without injury to anyone. On all of these flights, the machine, the instructor, and everybody who was on the ground over which these airplanes flew, were covered by insurance.

Considering the economy of flying, we find that, because no permanent roadway has to be put down, such as for motor cars or train traffic, the long-distance airline has to support only the cost of operation of its terminal airport. For any distance greater than 500 miles, which takes about five hours to fly, we find air transport the cheapest as well as the least tiring method of traveling, or of sending one's most valuable freight or mail. It will come as a surprise to most people to learn that the insurance rate for that most precious commodity, gold, is one third less by air than it is by what we call "surface transport." But this speed, comfort, and pleasure, are useless unless we can make flying safe for everybody.

FAR more so than in Europe, the American continent is going to develop its airlines. The Stout Air Lines claim to be the possessors of the lowest insurance premium per passenger-mile, of any airline in the world, although the amounts offered in case of injury are by no means the smallest.

When an airplane is doing what it is built to do—flying—there are four things to be looked after, if we are to make the word aviation synonymous with safety; these are the machine, the engine, the pilot, and the passengers. The same reasoning applies equally to the tiny two-seater, and the great four-engine airliner.

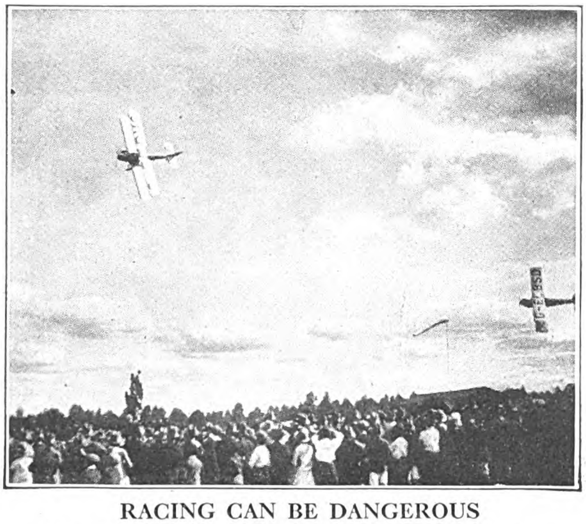
First of all, we want an airplane that is absolutely sound in all respects. Its flying qualities and its construction must be good. How it behaves in the air depends on the designer long before the ship ever comes out on the flying field.

The well designed airplane will practically fly itself. Madame Florman, of a famous Swedish construction company, and herself a pilot, told me the other day of a tour she took around Europe with her husband and three friends. In good weather they would set their big Junkers on its course and on even keel. Then they would make up a foursome of bridge in the cabin, leaving only one person in the pilot's cockpit to watch for any alteration of drift or possible changes in external or internal conditions.

But all flying is not fair-weather flying. Passengers are not taken on the airlines if the weather conditions are such that flying will be dangerous or uncomfortable. The ambition of all those in the industry is to make people want to fly again. Nevertheless, on a long flight, bad conditions sometimes arise, and the machine must be so airworthy that it will weather any storm that may occur.

On the airlines in Great Britain, the government insists that machines have a minimum factor of safety of seven, which means that the machine must be seven times as strong as it need be to meet normal conditions. Commerical machines need not be thrown about like fighting ships of the army and navy, but when I say that the fast loop, one of the most common maneuvers, uses the factor of safety only up to three, you will realize what a huge margin of safety a factor of seven gives.

AS a pilot of little sport planes, I have often grumbled at the high price of my mount. But when I have struck bad weather over the Alps, or in tearing, sand-bearing storms in the

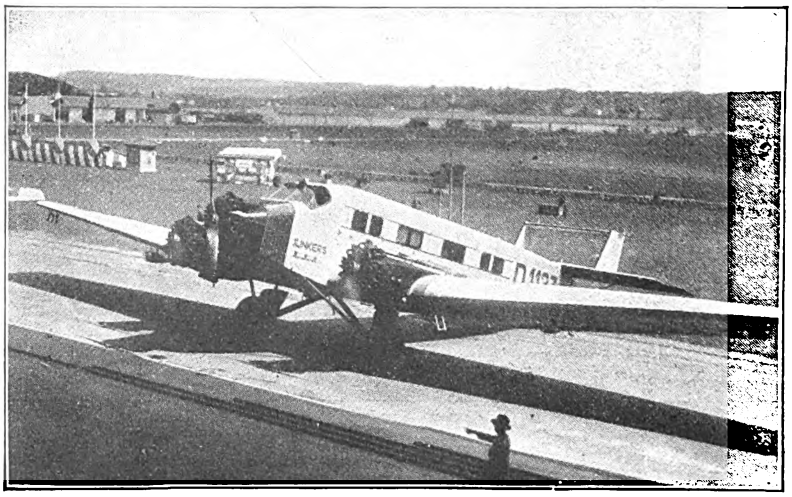


RACING CAN BE DANGEROUS

Many aviation fatalities are due to racing or stunting with inferior airplanes or by inexperienced pilots

MULTI-ENGINED FOR SAFETY

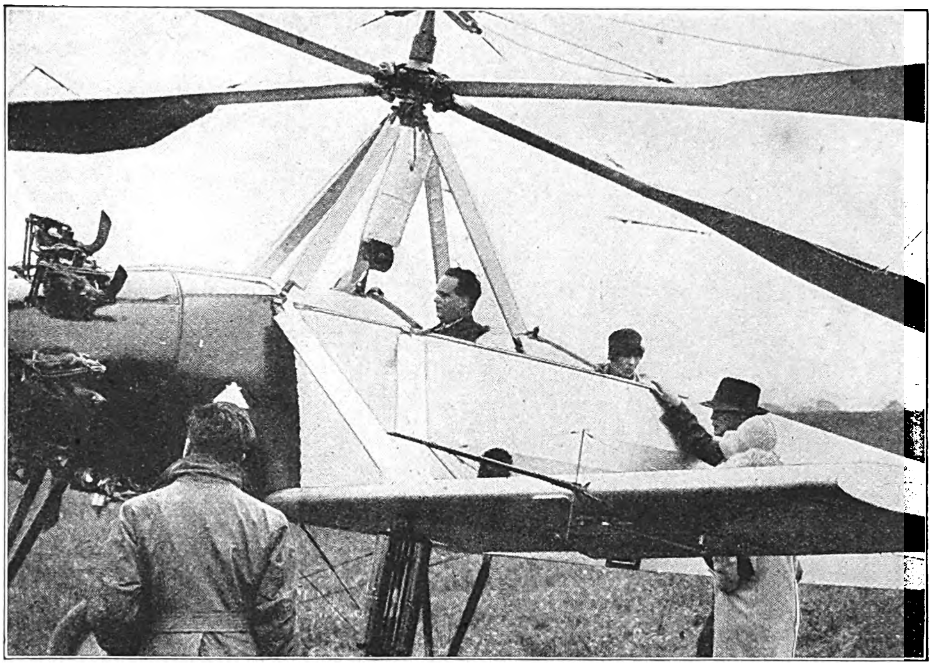
Large airplanes, carrying a crew and passengers, are usually equipped with two or three engines. They can fly with any one engine stopped



deserts of Africa, and have been tossed about like a feather until my body was bruised and blue from being thrown from side to side of my cockpit, I have thanked the "powers that be" for making me pay extra for that large factor of safety.

It is a wonderful experience to go through one of the best American airplane factories which produce machines that have a factor of safety as high as 10, and to see all the materials checked and examined before they are made into the different parts. Then one sees each tiny part checked and stamped before the plane is assembled. Another examination is given before the test pilot steps into the machine.

There are various devices which are being attached to ordinary machines to make them secure and more reliable. The most interesting of these today is the Handley-Page automatic slot.



SENOR JUAN DE LA CIERVA AND THE AUTHOR

They are shown here in the cockpits of de la Cierva's "flying windmill," or Autogyro. Ships of this type, when perfected, may contribute in great measure to increased aviation safety

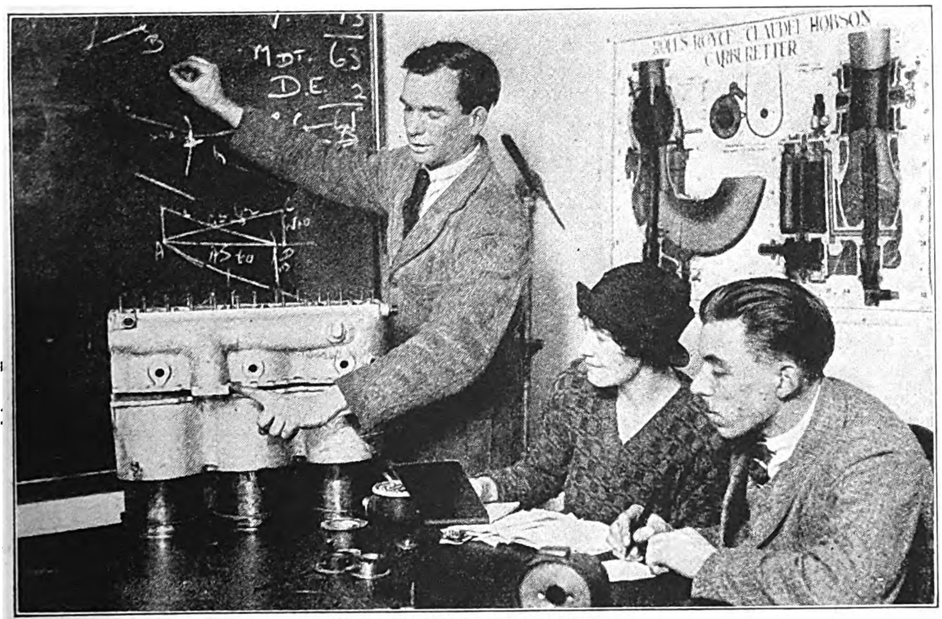
THIS contrivance saves the machine from the spinning nose dive that has so often ended fatally. The slot is a very simple thing, structurally. It is composed of a strip of metal along the front edge of the wings, fitting snugly to the curve. When the machine slows up too much, owing to any cause—usually an error of judgment of the pilot—this strip of metal automatically swings out on its hinges, and the slot between it and the wing re-creates over the surface of the wing the flow of air that keeps the ship balanced and controllable. Then if the airplane does come down, it descends on an even keel like an elevator, instead of diving downwards with great discomfort and probably danger to those inside.

Another device for avoiding the "stall" is the Bramson anti-stall gear. This merely jerks the control lever of the airplane sharply whenever the minimum flying speed is approached and reminds the pilot that by some means or another he must gain more speed to keep his ship afloat in the ocean of the air.

Another interesting invention from the point of view of safety is the La Cierva Autogyro, in which four freely rotating blades, constituting a giant horizontal windmill, act as a substitute for the conventional fixed wings. The Autogyro can land on a very steep path, very slowly, and stops within some 50 feet after landing. It has considerable promise as a machine for the private owner.

I have had the pleasure of flying with these three devices which attack problems of flight in different ways; but when I fly as a passenger I prefer to have the added assurance that the pilot is so fine that he will not need any of them.

To add to the safety of the machine, external fittings are very often added. One notices the familiar fire extinguisher, although it is practically never needed. And the parachute, although its presence is consoling, is seldom needed on the big commercial airlines. Its chief function is for the test pilot, that brave man who must take up a new airplane every day or two to find out what it will do under all circumstances of normal and abnormal flight.

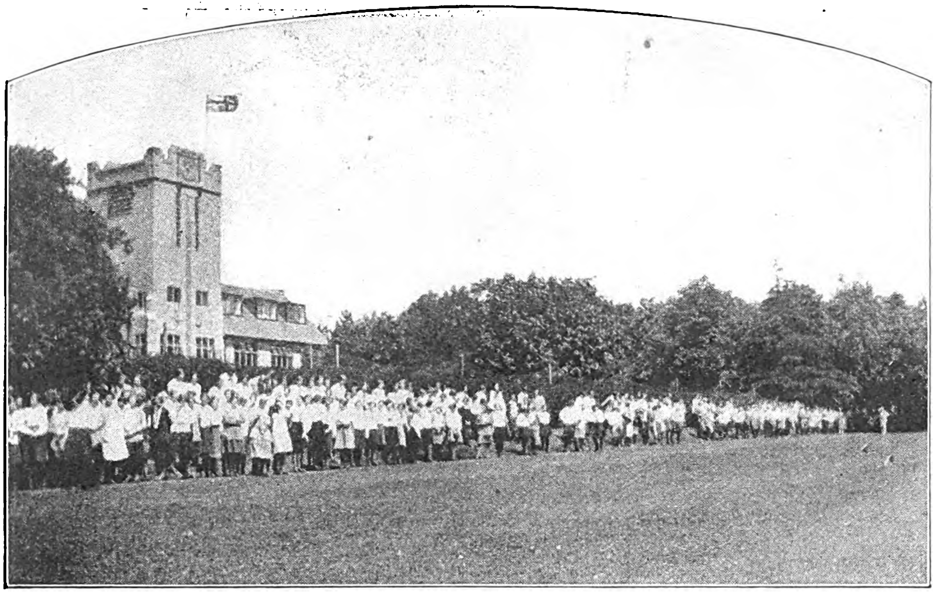

ROLLS ROYCE CLAUDEL HOBSON CARBURETTER

KNOWLEDGE IS SAFETY

A good pilot must have a thorough knowledge of aviation from all angles. Well organized schools of instruction make it possible for anyone to obtain this necessary information

SOME of the airlines refuse to carry parachutes because they might remind the passengers of danger. But who is perturbed by the life boats which stand on the top deck of every ocean going liner?

No matter how perfectly any piece of mechanism is made it is subject to wear and tear. For this reason a most elaborate system of ground examination is necessary for the safety of passengers. Every day a qualified mechanic goes over the ship in detail and signs a report. Then an engine man does the same thing for the engine. The pilot must then take the machine into the air to test it and when he comes down, must countersign the report before a single fare-paying passenger is taken up. Once a year each airplane is taken apart, and even the most minute parts are examined and replaced if worn. The same care is given the engine but the examinations are more frequent. The engine receives "top overhaul" after every 150 hours in the air and a complete



GREAT EXCITEMENT

This group is composed of students of Shelbourne School, Dorset, England, who turned out to meet Lady Heath when she landed on their play field to deliver a lecture on aviation

overhaul after every 300 hours of flying.

The reliability of the engine itself is in the hands of the big engine construction companies. The engines that carried the dozens of machines through the National Air Races last year, were guarded by well-designed cowling for protection from the wearing sands of the desert, or the insidious water vapor of humid patches of the atmosphere. When we think of those gallant engines that took Lindbergh, Miss Earhart, Chamberlin, Koehl and his companions, Alcock and Brown, and Reed, across the hungry stretches of the Atlantic, we realize that engine reliability is assured.

WHEN Great Britain, at my request, asked that the international law be changed to permit women to have commercial flying licenses, they wanted to set a standard of feminine efficiency. We brought half a dozen of our women Olympic athletes to our medical board for careful examination. It is the same with the male pilots. Olympic standards are used as the basis of selection of every air-mail pilot and every pilot who has the lives of passengers in his hands.

The preliminary examination takes hours and hours; sight, hearing, sensitivity, health, habits—everything is taken into consideration, even one's family history "unto the third or fourth generation." Even that is not enough. The pilot must come back every six months to have his license renewed, so that it will be known if he has fallen from the high standard.

Besides his (or her) fine physique, the commercial air-transport pilot must have a veritable encyclopedia of knowledge to fall back on if anything should go wrong. He will not get his license until he knows enough about meteorology to be a weather prophet, and he must know nearly as much about the machine and the engine as the constructors do. He must have learned all the laws of navigation and the etiquette of the air and must already have a long record of safe flying before the insurance companies will permit the airlines to employ him.

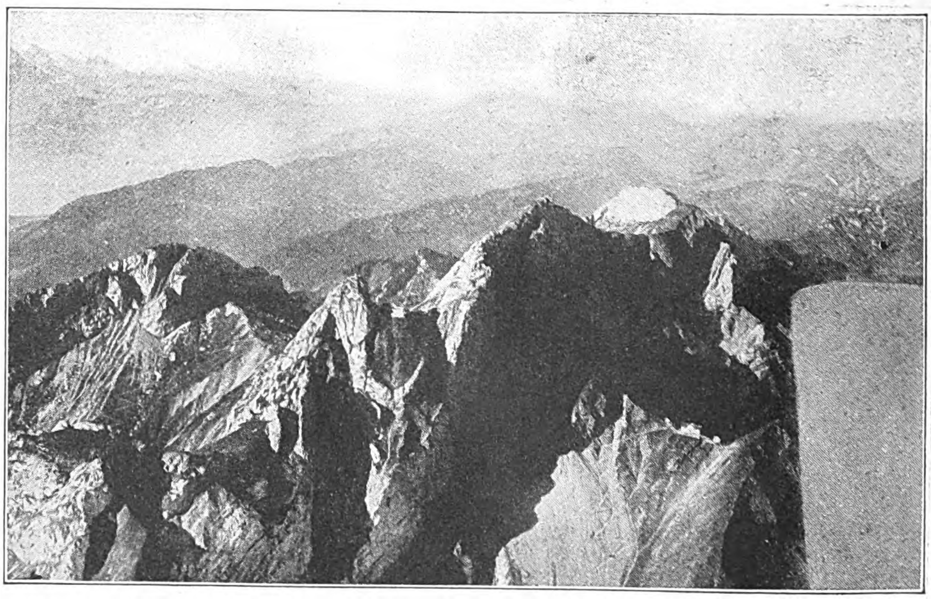
There are several other factors which should be considered. It is a waste of time and money to build the most beautiful machines in the world unless we have good landing fields. The split axle of the modern machine, which will not trip over any obstacle, is useless if the landing surface is so bad that a wheel will catch and stick in a rut. It is imperative that we have many landing fields with good surfaces. Foot brakes to stop planes in a short distance are now supplied on most machines; but large surfaces, at least 1000 yards in every direction, are needed to keep up the high standard of safety we are attaining.

THERE should be landing grounds between big flying fields. To my mind, the most wonderful system of air lines in the world is that which is operating quietly, unobtrusively, and without accidents, year after year, in the Belgian Congo, traversing thousands of miles of jungles, lakes, and mountains. They have built emergency landing fields every 20 miles. Admittedly, this is expensive, but to save one human life should justify the expenditure of millions of dollars.

The air-mail pilots of America have a wonderful system of light and radio beacons to guide them at night and through all kinds of weather. The night-flying passenger services of other countries have these too. Thousands of scientists are working on such problems as fog dispersion, fog-piercing lights, and directional wireless.

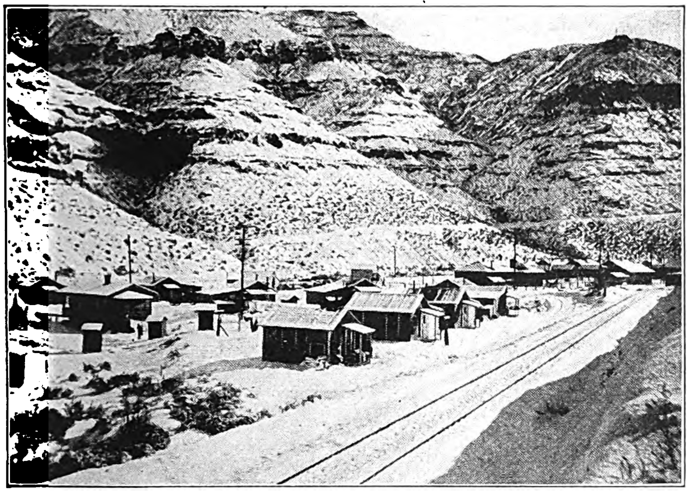
Excellent maps have been especially prepared to show the pilot, at a glance, the salient topographical features of the locality over which he is flying. Back of this map service there is a continental and world-wide weather bureau, giving out reports for the guidance of every pilot, amateur or professional, as he goes into the air.

Today, America leads in aviation, and to keep that lead, all her citizens must work together for the good of the great industry that has grown out of the successful experience of two of her sons 25 years ago. America must help international aviation, too, for she has given something to the world that is greater than national supremacy in aviation—an industry which is making for a happier, a more peaceful, and a safer world.



DANGEROUS FLYING COUNTRY

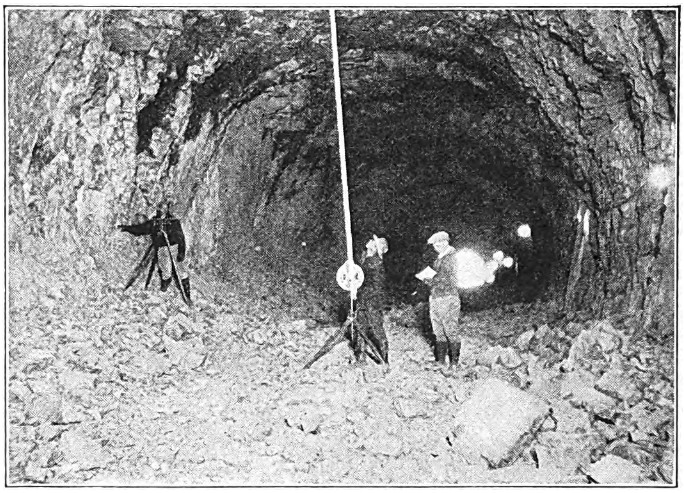
Aviation traffic over the Alps requires a complete weather reporting service. This has been perfected by the Austrian, Swiss, and Italian governments to such an extent that their airway lines are said to have a much better record of safety than their railroads



Courtesy Bureau of Reclamation, Department of the Interior

WORK ON THE DAM HAS BEGUN

Workmen's camp at the damsite. As the work progresses and work on the dam itself is started, this camp will grow rapidly



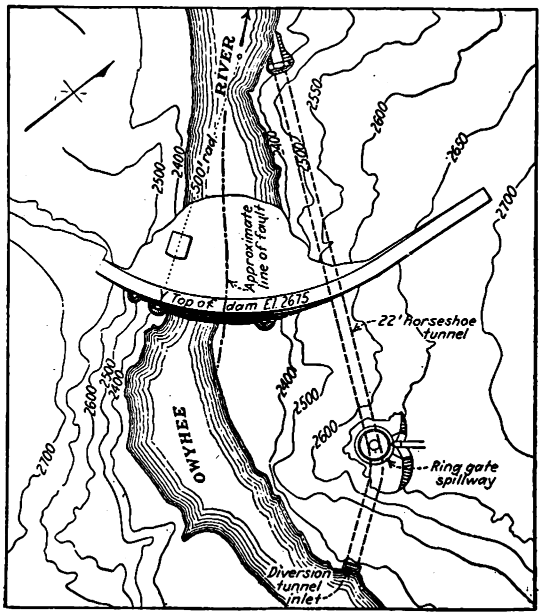
CUT THROUGH SOLID ROCK

The river diversion tunnel through which the river will be diverted during construction and which will be the spillway later

The World's Highest Dam for Irrigation

WHAT will be the world's highest dam at the time of its completion is being built by the Bureau of Reclamation at a point on the Owyhee River in Oregon that was once used as a rendezvous by cattle rustlers. Known as the Owyhee Dam, it is the principal storage reservoir for the Owyhee reclamation project and its impounded waters will be used for the irrigation of 120,000 acres in Idaho and Oregon, and for the incidental generation of electrical power.

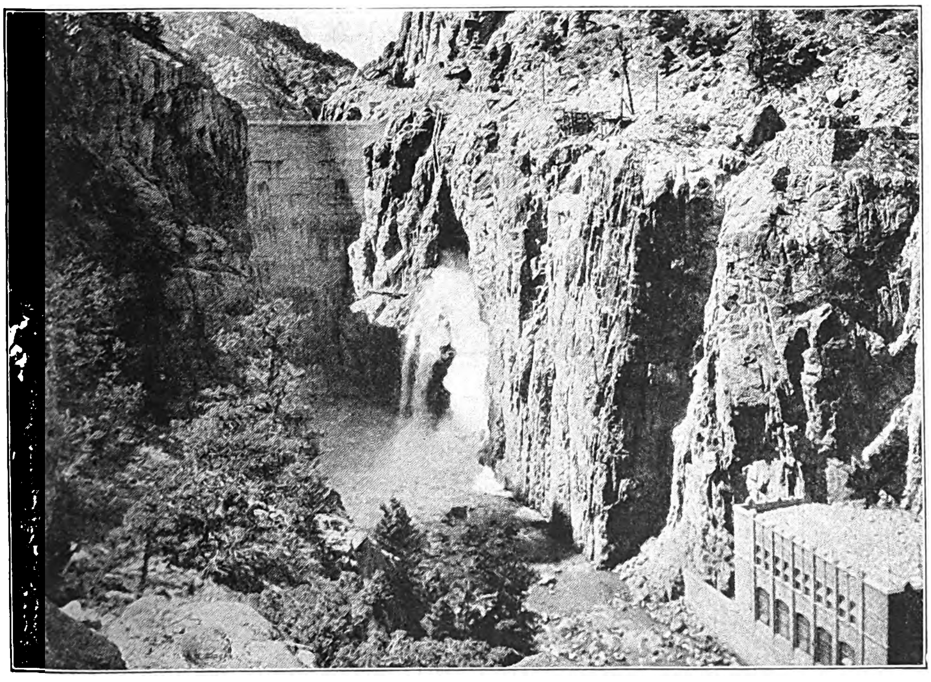
The dam will be of concrete and of combined arch and gravity type; 405 feet high at its highest point; and will have a total capacity of 1,120,000 acre-feet. It is particularly significant that, in the planning of this dam, extensive geological and engineering investigations preceded approval of the site and designs. According to Mr. J. L. Savage, of the Bureau, the design of the structure called for the development of a number of features new in dam construction. While spillways through solid rock around the end of dams are not new, this feature is of special interest in the Owyhee Dam. It consists of a 22-foot tunnel, concrete lined and 1005 feet long. During construction, it will divert the river water but later will be connected with the vertical intake shaft which stands 240 feet high. The top of this spillway is a funnel lip on which is to be installed a radically new type of ring gate, this latter being a circular spillway controlled by a ring gate.



Courtesy *Engineering News-Record*

THE DAMSITE

Drawing, with contours, to show dam, spillway through rock, and rugged nature of the country where dam is being built



IN SOME RESPECTS A SIMILAR DAM: THE SHOSHONE DAM

The spillway of this dam was cut through solid rock, as were also the penstocks to the power house. This dam in Wyoming was built for power generation and irrigation

Provision has been made in the design of the dam for the future installation of a power plant to utilize the flow of prior right water, that is, water on which rights for irrigation purposes are held. Two six-foot conduits are provided, each to be controlled by a five by six-foot cast iron emergency gate operated by oil pressure. An innovation in dam practice is the installation of elevators in the dam itself for carrying up supplies and heavy repair parts.

THE STUDENTS STAGE A PLAY

This scene shows the opening of the first act of "The Fan." The scenery, properties, and costumes were all made by the students in the drama course, who also act various parts

The Stage Goes to School

All Phases of Stage-craft are Taught in New Course in Drama

By CHESTER M. WALLACE

Professor of Dramatic Art, Carnegie Institute of Technology

THE Drama Department of the Carnegie Institute of Technology is organized on the principles of a professional repertory company. During eight months of school there are fifteen regular productions, or about one every other week. The average "run" of a show is ten performances. One can readily see the high degree of organization required, and the skill needed by the students, who do all the construction, painting, lighting, and stage-managing on these dramatic productions. To make this possible the students who do the stage work must have a thorough knowledge of the principles of production, and of equipment on hand in applying these principles.

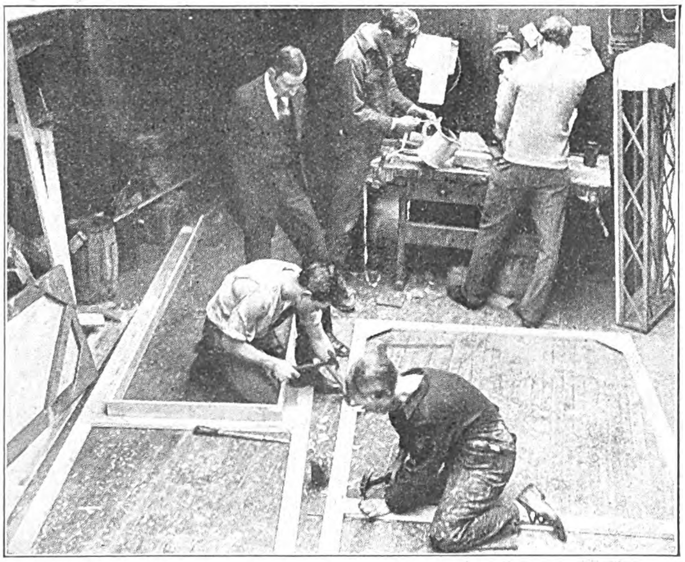
There are two purposes in such organization: (1) to put on the scheduled shows as professionally and efficiently as possible, and (2) to instruct the students in the principles and craft of stage work. The stage-craft class furnishes a link between these two points of practice and theory.

The freshman class in elementary stage craft receives one lecture a week, coupled with the crew work in the theater, which occupies about twelve hours. Each show is brought up before the class several days before the actual work on it commences. Its problems are discussed and analyzed, and often student designs are accepted and put into practice. Thus the students are prepared to make the most of the equipment at hand, knowing that every hinge and corner-block has its purpose.

The lecture course consists of a series of 32 talks on stage-craft, divided roughly into eight divisions. The first few cover construction and equipment—the names and uses of the different units of settings: flats, drops, platforms, steps, pillars, runways, arches, and bridges—the posts

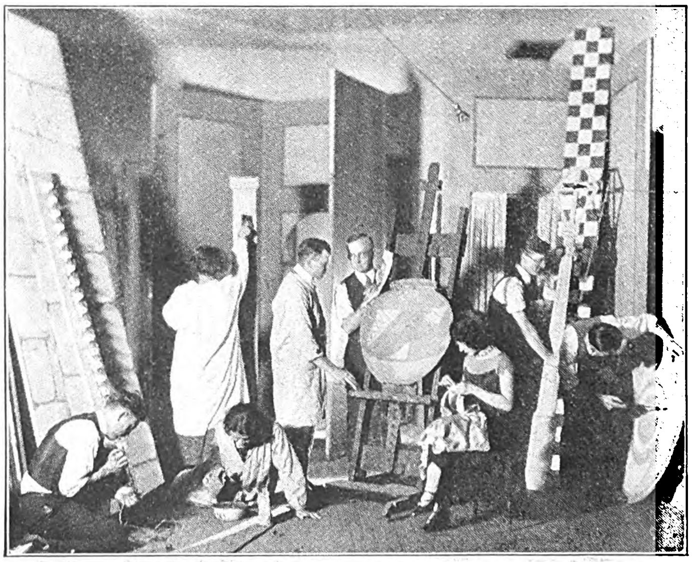
A PAINT FRAME

The students are taught the art of scene painting, a subject not easily learned



STAGE CARPENTERS

Practically all scenes call for wooden frames. Here the students are being instructed in the proper manner of making these parts



PROPERTY MAKING

Every play requires a number of "props" or various objects to give local color. Each must be carefully designed for proper effect

WARDROBE MISTRESS

Wear and tear on costumes is such that the sewing machine and pressing iron are always in demand

Supplementing the freshman work in stage craft are the upper-class options of scene painting, lighting, and model-making. The student taking scene painting is first instructed in the mixing of paint, a very complex process since unlike oils or house paint, every bucket of scene paint for every different purpose is mixed to a different consistency, the amount of glue, base, color, and water varying according to use.

Next the student is taught different brush finishes—ways of covering space on canvas, lumber, or wall board to get the most surface on each for the amount of paint used, and the amount of paint used to cover a given number of square feet of surface. Then one goes on to study the various finishes: sponging, stippling, cross-hatching and combining. Next comes the art of painting to imitate stone or wood, followed by lessons in graining, paneling, and painting high-lights and shadows so as to render under given lights the effect of relief and form on flat surfaces. The final and more advanced step is that which leads to the painting of foliage (tropical, northern, or temperate), landscapes (winter or summer), cycloramas (sky effects with broken colors on a flat surface) and false perspective, to simulate distance and depth, which is so often wasted in the actual theater of to-day.

THE course in electricity and lighting begins with a study of electrical conductors, open and closed circuits, amperage, wattage, and voltage, and the reading of measurements of electricity. This goes on to the study of simple resistance and reactance dimmers, and remote controls. The student is taught the use of the switchboard and plugging systems.

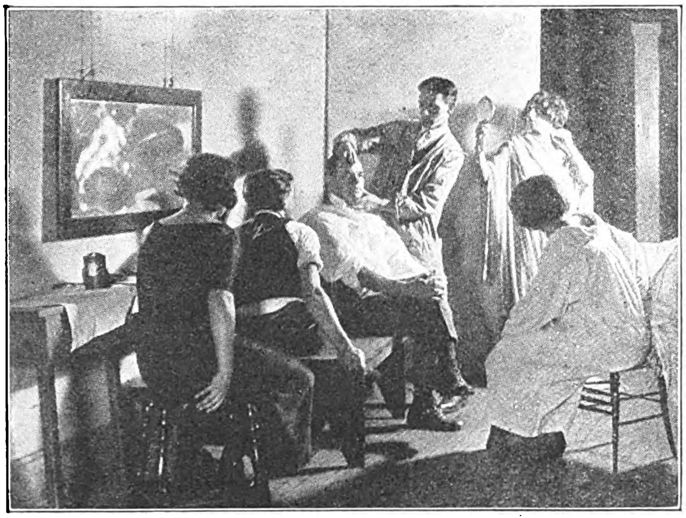
From this the student goes into simple intensities of light, and night and day effects. Then comes the use of color mediums, cones and diffusions, and the effect of different color filters on the range of colors in costumes, make-up, and scene paint, lighting for mood, character, and movement in relation to the play at hand, color contrasts used for illusions of distance, height, or depth, and lighting a setting and the actor in relation to the setting and to his particular needs in expression.

The students in model-making construct models to scale from the designs and working drawings of the plays as they go into production. Special instruction is given on materials and the use of diminutive perspective. In this way each show is first built in miniature and special problems of lighting and painting are studied out on the model before being tried on the stage in normal size.

Freshmen in the Drama Department receive three hours a week instruction in make-up. The men and the women are taken separately, since the problems encountered by each are entirely different. Each student receives individual instruction and criticism, and is taught how to make the most of his own facial and physical peculiarities in the expression of character through appearance. The group is assigned a different problem every week. These problems include old age, juvenile, Oriental, negro, stylized, and every type of make-up that the repertory actor is apt to be required to use.

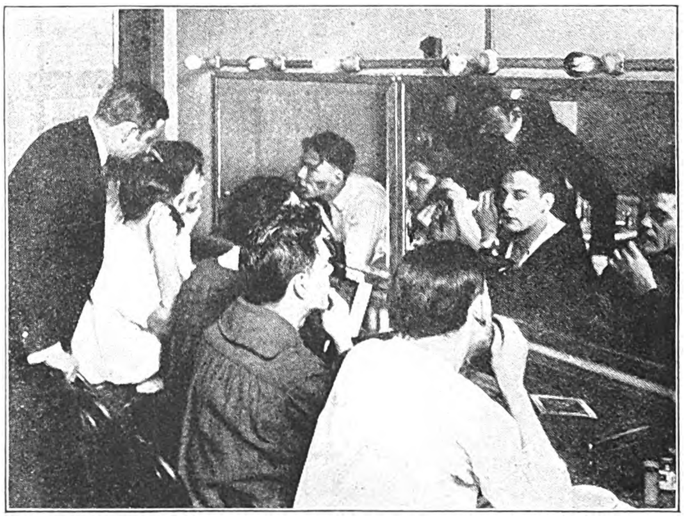
THREE or four classes every semester are spent in the dressing and use of wigs and beards, and in lectures on the various period styles of beards, mustaches, and hair-dressing, such as Elizabethan, Norman, Cavalier, and Victorian modes. During productions where the freshmen are cast as supers, such as courtiers, soldiers, crowds, and so on, the individual types and make-ups are worked out, and the students are allowed to try their make-ups under the various colors of lights before ever going on stage. When a freshman has completed this course, he is ready, as far as appearance is concerned, for any of the many different parts he will play in the three years to follow. No regular classes in make-up are given after the first year, but the students continue to develop skill because of the many and varied make-ups they are called upon to use in a repertory company.

Among the two hundred and fifty plays produced by the department during the past 13 years have been 14 of Shakespeare's plays and such classics as "Iphigenia in Tauris," "The Rivals," "She Stoops to Conquer," "School for Scandal," and several of the somber Ibsen plays. Modern examples have not been neglected. About eight performances are usually given.



MAKE-UP INSTRUCTION

Cold cream, grease paint, and rouge have to be applied properly. Make-up is truly an art, and is a foundation stone of the drama



INDIVIDUAL MAKE UP

The students are allowed the use of make-up tables such as they will find in regular theaters after they finish their school course

Underground Arteries for Oil and Gas

Pipelines Hundreds of Miles in Length Surmount Natural Barriers Transporting Fuel to Refineries and Distant Cities

By HENRY W. HOUGH

"HE stayed not for brake and he stopped not for stone, he swam the Eske river where ford there was none." Apparently something of the spirit of the gallant young Lochinvar inspires the modern engineer, who deftly draws a straight line between widely separated points on a map of the United States and calls it the right-of-way for a huge pipeline to transport oil or natural gas from the producing area to a distant refinery or city. Over mountains, down rocky precipices, through slimy swamps, across rolling prairies, and beneath turbulent mountain streams or wide rivers, the pipeline transports its fluid cargo without interruption or delay.

IN the early days of the petroleum industry, teamsters transported the "black gold" in tank-wagons; now, with the aid of powerful pumps, the oil surges through huge, black arteries of iron or steel, hundreds of miles in length. In all of our great oil and gas pipeline systems of today, we see the 20th Century development of the bamboo pipe used in China more than 2000 years ago to carry natural gas for lighting.

More than 80,000 miles of main and gathering oil lines now provide a great underground transportation system between oil fields in various parts of the country and ship terminals, railway loading racks, and refineries. The longest of the oil trunk lines extends from Texas to Bayonne, New Jersey, a distance of nearly 1700 miles. Many large cities, hundreds of miles from the source of supply, are receiving natural gas through pipelines from 16 to 24 inches in diameter, and a 1200-mile pipeline project now under construction will provide natural gas from the Louisiana fields to Birmingham, Atlanta, Chattanooga, and other southern cities.

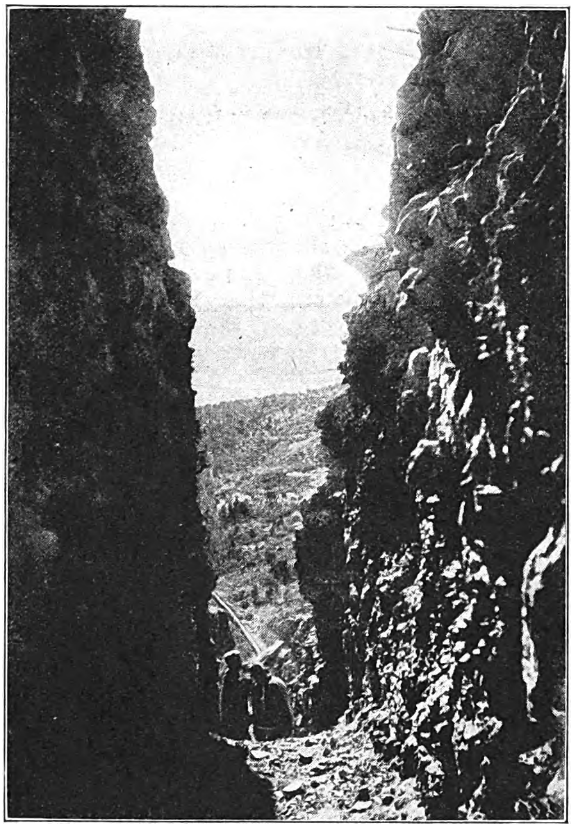


Photo courtesy Ford, Bacon & Davis Inc.

DOWN A ROCKY CANYON

This pipeline trench was prepared for a 24-inch pipe which transports natural gas 375 miles

The mileage of main natural gas lines in the United States almost equals our 81,000 miles of manufactured gas lines. This is particularly significant in view of the fact that most of the larger natural gas projects have been built within the past two or three years, while the manufactured gas lines have been extended gradually since the first American coal-gas plant was built in Baltimore in 1812.

INDUSTRY keeps its eye on the clock—or the calendar—and the keynote speech of every pipeline engineer is, "Rush it!" Some time ago, when we watched the husky crews of workmen swing into action on circus-day, quickly transforming a trainload of poles, canvas, wagons, and animals into a glamorous spectacle fit to delight the hearts of the town's future presidents, we were willing to admit that human efficiency had about reached perfection. But modern industry sets a new standard for speed in construction. Recently a 30 million dollar pipeline project, nearly 400 miles in length, was built, tested, and pronounced ready for service within 90 days after starting construction.

As soon as the right-of-way has been surveyed, and satis-

Photo courtesy Ford, Bacon & Davis, Inc.

OVER THE HILLS AND FAR AWAY

Hundreds of miles of gently sloping hills and prairies of the west provide a comparatively good right-of-way for the pipelines

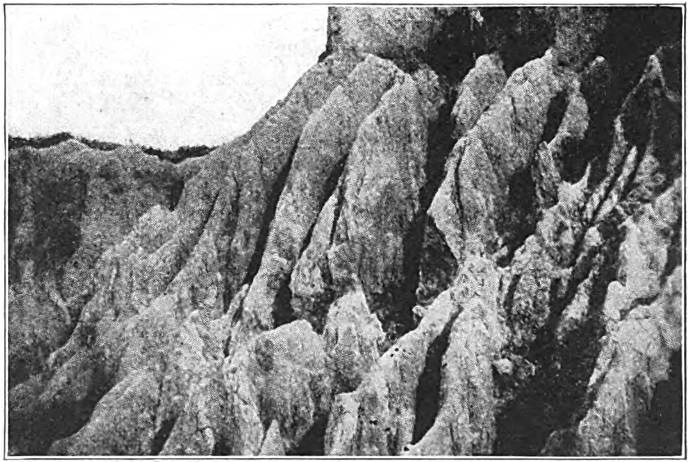
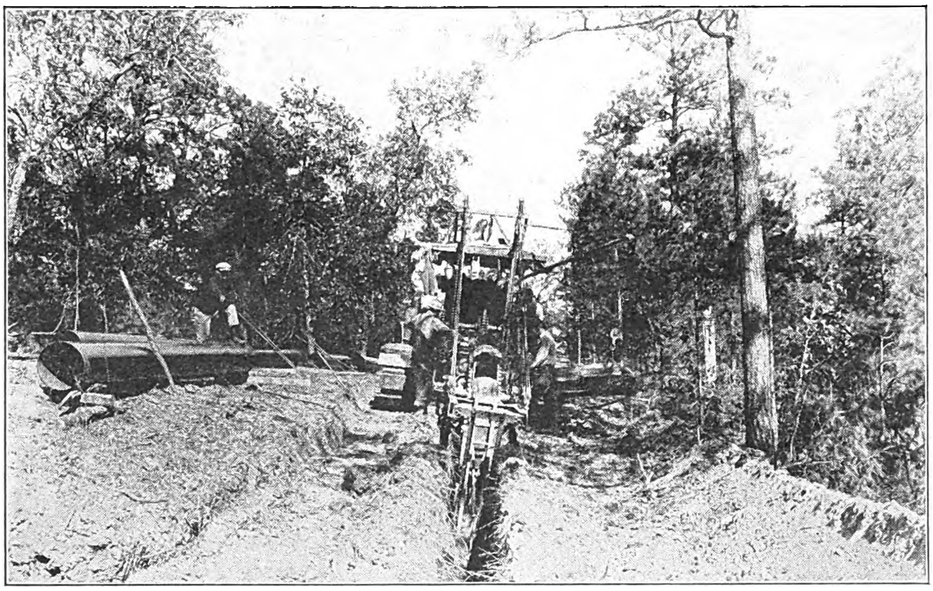


Photo courtesy J. W. Richards & Son

ERASING A MOUNTAIN WITH WIND AND RAIN

An example of severe erosion. This picture was taken in Mississippi, during a soil corrosion survey for a 900-mile gas pipeline



PREPARING A PIPELINE TRENCH WITH A DITCHING MACHINE

Several miles of trench can be prepared in a day with one of these powerful ditching machines. In such places as this the progress is rapid, but in many places the trench must be dug by hand

factory arrangements have been made with the owners of the land through which a proposed pipeline is to run, a survey is made to determine the intensity of sub-soil corrosion that must be expected all along the line. If the pipe is not adequately protected, in corrosive soil, it will soon be destroyed by rust. The right-of-way crew then clears the ground of any trees, boulders, or undergrowth that might be in the way. Ditching machines prepare the trench, usually deep enough to leave two feet of "fill" over the pipe when it is in place. Several crews of workmen with trucks or wagons begin "stringing" the pipe parallel with the trench. Each of these tasks presents a variety of problems, and specially trained crews are used for each phase of the work.

EXPERT welders then connect the various sections of pipe, or, in some cases, the sections are joined together with couplings. Both oxy-acetylene and electric welding methods are used extensively, but the recent trend has been toward electric welding. When in service the pipe has a tendency to expand and contract, and for this reason expansion joints and elastic couplings are usually provided. Sometimes the pipe is "snaked" from side to side on the bottom of the trench to accommodate the strain when the pipe contracts.

After the pipe is welded or coupled, each joint is inspected, and the necessary protective coating is applied. Usually the coating is a hot, thick layer of asphaltic or coal-tar-pitch material, and must be permitted to cool and harden before the pipe is lowered into the trench. When the pipe is finally in place, the backfilling gang replaces the dirt extracted by the ditcher; in most cases this is done mechanically, using a small tractor equipped with a swinging boom and scraper. The "damage man" then restores any fences that have been temporarily removed, repairs ditches or tiling, and seeks to pacify irate farmers in case a tree, road, or other personal property has been damaged.

During the construction of an oil pipeline, pumping stations are installed about every 40 miles. Compressor or "booster" stations are provided about every 100 miles on a natural gas line, to give the gas less volume and higher pressure. A gasoline extraction plant is usually built at some convenient location on a natural gas line. When all of the various sections of the line have been connected, it is tested at high pressure for leaks, and, if satisfactory, is pronounced ready for service.

Each pipeline project presents a different set of problems that must be worked out by the engineers in charge, or by the specialists under their supervision. Unusual topographic conditions are frequently encountered, such as canyons, swamps, quicksand, and crossings under highways, railroads, or rivers. As most pipelines traverse comparatively rough country, it is frequently necessary to build roads for transporting pipe and other materials. In rocky country, it is necessary to dig some sections of a trench with pick, shovel, and explosives, instead of with ditching machines that can ordinarily prepare several miles of trench a day.

ONE pipeline company owns 12,500 miles of trunk and gathering oil lines, including one trunk system extending from Tiffen, Texas, through Oklahoma and Kansas to Carrolton, Missouri. There it branches, one line going east to Wood River, Illinois, and the other northeast through Iowa and Illinois to Griffith, Indiana. This company's lines deliver more than four million barrels of crude oil a month, in just three of the mid-continent states. Of the major projects now under construction, the largest is the Texas-Empire trunk pipeline consisting of 636 miles of 12-inch pipe. Its terminals are Tulsa, Oklahoma, and Chicago, Illinois. Several projects more than 400 miles in length are now under construction in Texas.

During the past year, many important natural gas pipelines have been constructed, and several of equal or greater size are now being built. Among those which have been completed recently, or are now under construction, the following are most notable: from the Panhandle fields in Texas to Denver and Kansas City;

PUTTING THE FINISHING TOUCHES ON A NATURAL GAS TRUNK LINE

After the trench has been prepared, the pipe is welded or coupled, and a coating of paint or enamel is applied for protection against corrosion. The pipe is then ready to be buried from Baxter Basin in Wyoming to Salt Lake City; from Lea County in New Mexico to El Paso; from the Buttonwillow field in California to Oakland and San Francisco; and from the Louisiana fields to New Orleans, Memphis, St. Louis, and Birmingham.

An interesting feat of engineering was accomplished in constructing the Mississippi River crossing when the natural gas pipeline from Monroe, Louisiana, to Memphis, Tennessee, was built. Lyon F. Terry of the Ralph E. Davis engineering organization supervised the construction of the line, including the river crossing. Massive concrete headers were built just back of both levees, where the 18-inch trunk line was subdivided into four 10 inch pipes about 12,000 feet long.

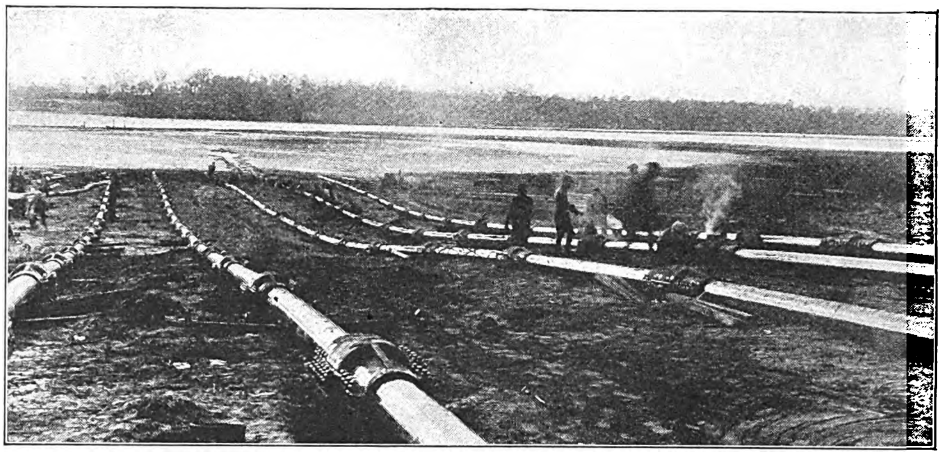


Photo courtesy Ralph E. Davis

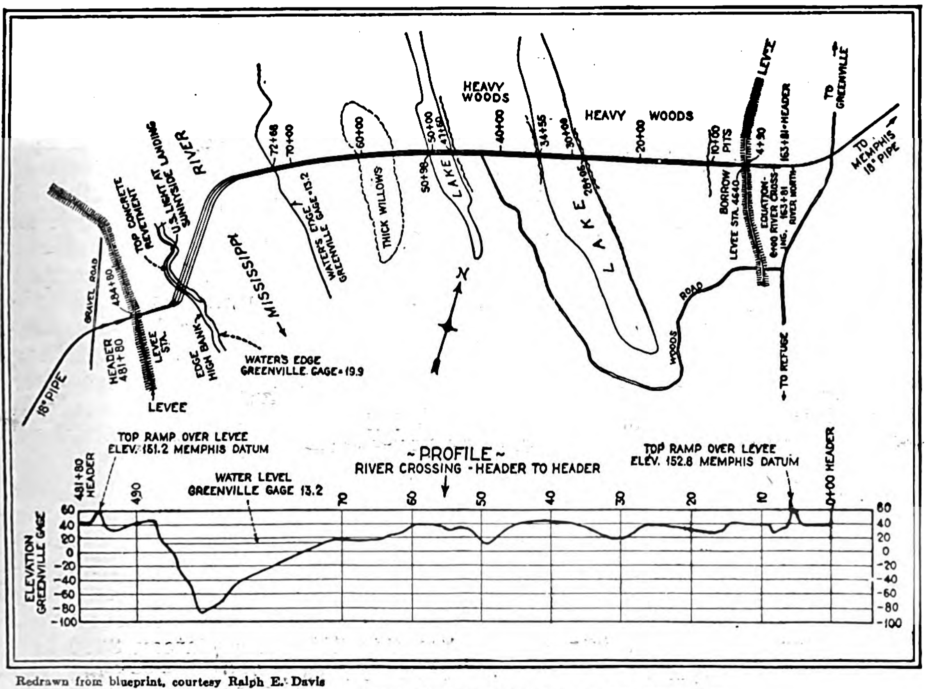
TRANSPORTING NATURAL GAS UNDER THE MISSISSIPPI RIVER

When crossing a large river, several small parallel lines are built, with heavy weights to keep the pipe in place. The joints are screwed together, carefully enameled, and heavily weighted

FROM levee to levee, the line had to traverse two thickets, two small lakes, a swamp, an 800 foot mud flat, and the 3000 foot main channel of the river, which was about 80 feet deep at that point. Ten-ton concrete anchors were placed at intervals across the main channel, and the pipe was joined together and lowered from barges and pontoons, held in place by the anchors and two tug boats. The joints were screwed together, fitted with collar leak clamps, coated with bitumastic enamel, and weighted with 1800-pound river clamps. The four parallel lines lie in a neat up-stream bow, designed to withstand the periodic rampages of "old man river."

Corrosion causes more than 100 million dollars worth of damage to pipelines every year. As a result, the cause and prevention of soil corrosion has been the subject of much study and research. It has been definitely established that corrosion is severe in some soils, moderate in others, and in some areas it can be considered almost negligible. Protection against rust is principally a matter of insulation—if moisture and corrosive salts or acids can be kept from the surface of the pipe, corrosion will cause no trouble.

The most effective protection against severe corrosive conditions is heavy cast iron pipe, or such metals as are known to be resistant to oxidation or rust. But in the interest of economy, wrought iron or steel pipe is usually used, and to guard against untimely destruction, paints or thick coatings of asphaltic or coal-tar-pitch material are usually applied. In extremely dangerous areas, wrappings of asbestos or felt are sometimes added to keep the coating in place, although a well-applied layer of protective enamel will withstand corrosion almost indefinitely. By means of a complete corrosion survey, in which the surface characteristics and the inherent corrosive characteristics are evaluated, it is possible to determine the potential corrosiveness at all points along a pipeline right-of-way, or in such areas as gas or water distribution systems.


HEAVY WOODS
HEAVY WOODS
LEVEE
TO GREENVILLE
TO MEMPHIS 18" PIPE
72+68
70+00
60+00
50+00
41+50
40+00
34+55
30+00
20+00
10+00
BORROW PITS
4+30
163+81-HEADER
RIVER
U.S. LIGHT AT LANDING SUNNYSIDE
TOP CONCRETE REVETMENT
WATERS EDGE GREENVILLE GAGE 13.2
THICK WILLOWS
50+98
LAKE
26+05
LAKE
LEVEE STA. 46+40
EQUATION- 0+00 RIVER CROSS-ING. 163+81 RIVER NORTH
MISSISSIPPI
GRAVEL ROAD
484+80
HEADER 481+80
LEVEE STA.
EDGE HIGH BANK
WATERS EDGE GREENVILLE GAGE 19.9
N
ROAD
WOODS
TO REFUGE
18" PIPE
LEVEE
TOP RAMP OVER LEVEE ELEV. 151.2 MEMPHIS DATUM
~PROFILE~ RIVER CROSSING - HEADER TO HEADER
TOP RAMP OVER LEVEE ELEV. 152.8 MEMPHIS DATUM
481+80 HEADER
490
WATER LEVEL GREENVILLE GAGE 13.2
70
60
50
40
30
20
10
0+00 HEADER
ELEVATION GREENVILLE GAGE
60
40
20
0
-20
-40
-60
-80
-100

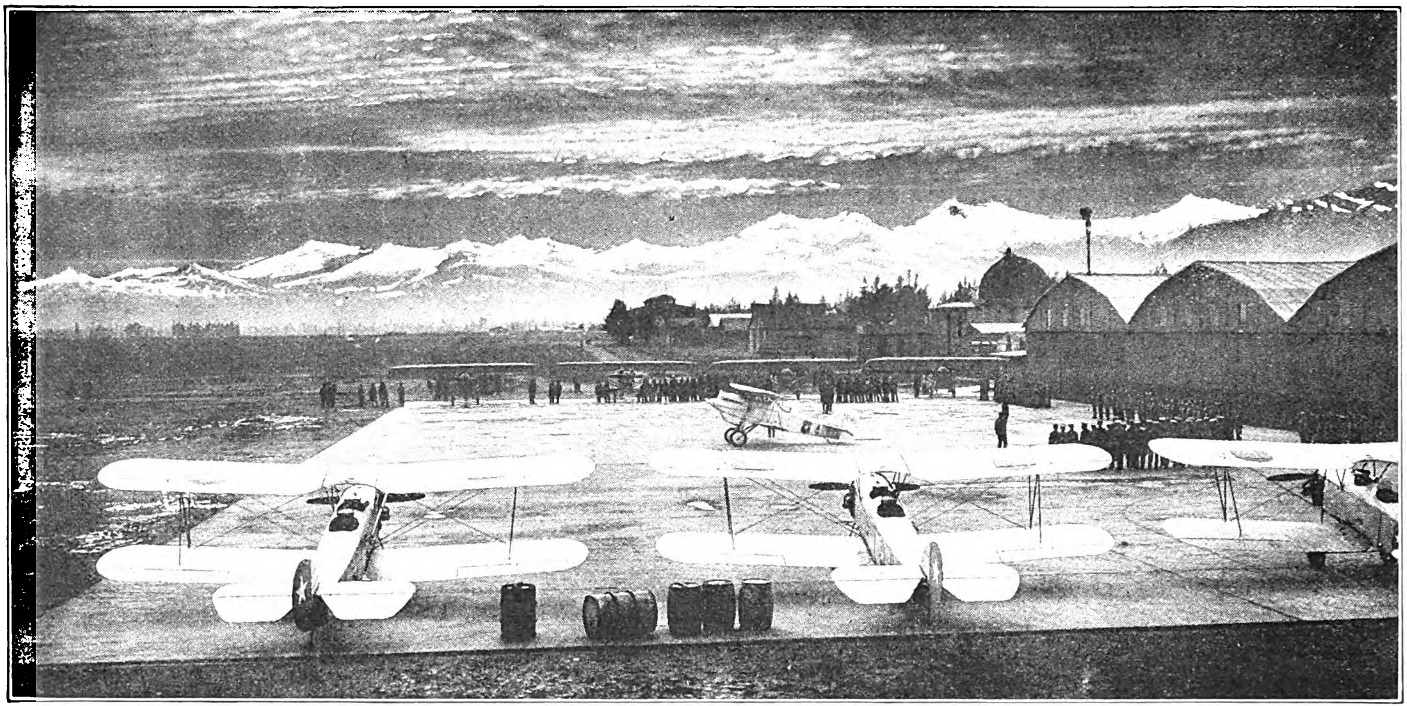
Redrawn from blueprint, courtesy Ralph E. Davis

HOW "OLD MAN RIVER" WAS CONQUERED

Although it is 12,000 feet from levee to levee, the main channel of the river is about 3000 feet wide at low-water stage. Note the up-stream bow in the pipe across the main channel

CONNECTIONS and joints are the most vulnerable part of most pipelines, and are frequently the source of leaks or breaks. A new expansion joint has recently been perfected for use on all-welded lines, which automatically absorbs expansion and contraction, acts as a bending medium, and provides a leak-proof joint. Another device recently developed for use on long-distance high-pressure lines is a coupling coater, which is a hinged aluminum form built to clamp tightly around the coupling. The melted enamel is pumped into the bottom of the form, until it completely submerges the coupling; the excess enamel is then drawn out, by reversing the pump, and the coupling is left with a perfect coating.

Centuries ago people worshipped at "the everlasting flame" of Baku, an immense petroleum and natural gas deposit in the near-east. Today a 500 mile pipeline transports oil from Baku to refineries on the Black Sea. The line was welded by an American concern. In the Rheinish Westphalian industrial district of Germany, a 550 mile network of 16 to 32 inch pipelines transports manufactured gas from the generating plants near the coal mines to industrial and domestic users. Manufactured gas is supplied to 317 communities in Illinois by 1,269 miles of inter-city mains, and similar lines connect communities in New England that are dependent upon central generating plants for their supply of gas. Several cities in the middle west are now using natural gas to enrich their manufactured gas, with excellent results.



Photograph courtesy *Chile*

WAITING FOR THE SUNRISE

Dawn at "El Bosque," modern airport recently established in Chile, "The Lone Star Republic"

Wings of South America

Aerial Transportation Between the Continents of the Western Hemisphere Is Increasing by Leaps and Bounds

By ANNIE S. PECK

Author of "The South American Tour," "Industrial and Commercial South America," etc.

THE opening in May by the Pan American-Grace Airways, Inc., of the first regular air-mail service from the United States to South America, by way of Panama down the western coast, is to us as important as was to Europe the mail service from France to the eastern coast of South America, inaugurated in 1928. The east coast, too, now receives our attention, as in August a service will be opened by the New York, Rio and Buenos Aires Line, Inc. Thus a great stimulus will be given to inter-American trade and travel, promoting closer relations between the peoples of the continents of North and South America.

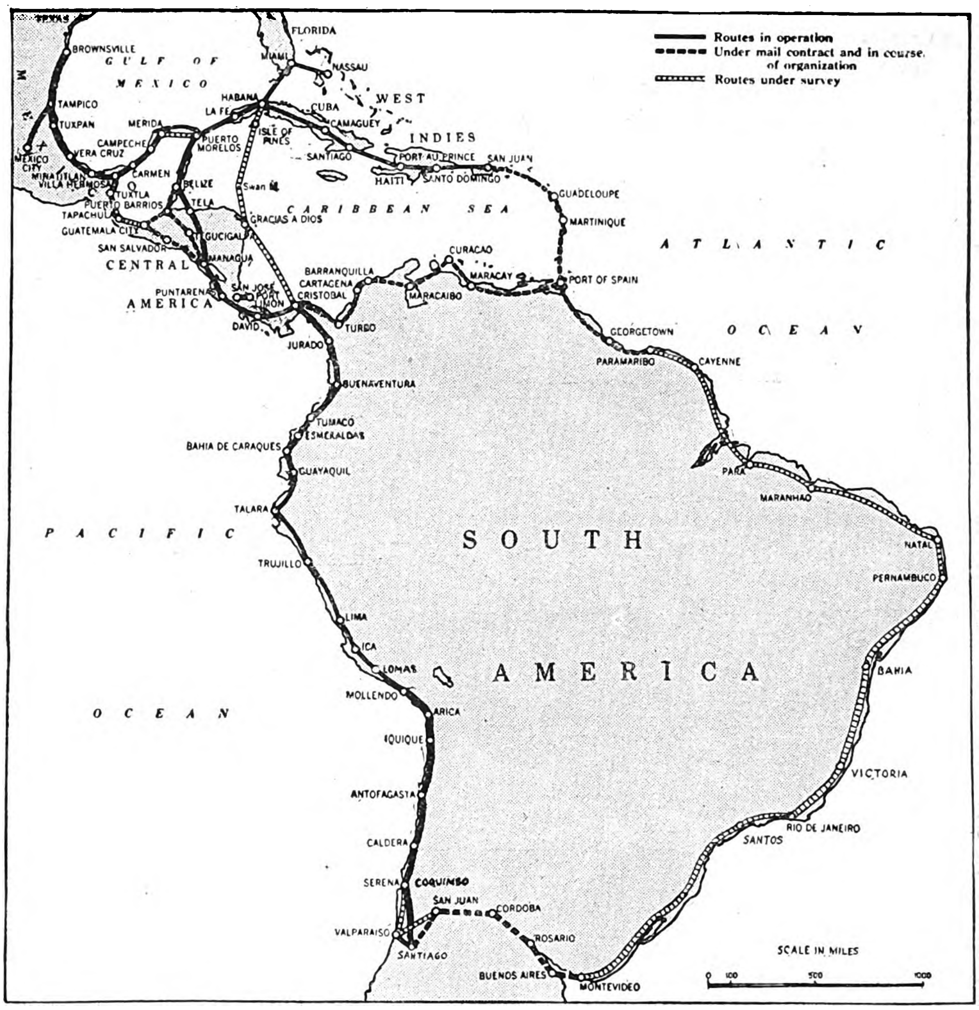
But let no one fancy that the sight of airplanes is a novelty to our southern neighbors. South America has been less laggard in aeronautical development than we may imagine. The friendly visit of Colonel Lindbergh to Central America, Colombia, and Venezuela, stimulated interest in aviation in the countries this side of Panama and was very welcome beyond, although there no stimulus was needed, since Colombia was the first country on this hemisphere to install regular air-mail and pasenger service on a definite schedule.

We are justly proud of our world-famous Wright brothers, the first to fly in a ship heavier than air—14 seconds in 1903, and more than an hour in 1908. But we must not overlook the skill and valor of the South Americans. It was a Brazilian, Santos Dumont, who, in a ship lighter than air, first flew, in 1901, around the Eiffel Tower, and in 1903 landed gracefully at his own doorway in Paris. A Peruvian, Georges Chavez, was the first to cross the Alps in an airplane. In 1918, the more lofty Andes were first traversed by a Chilean aviator, Lieutenant Godoy, while in 1923 the more perilous passage from east to west was accomplished by a French lady, Mlle. Bolland, alone, in a little plane with an 80-horsepower motor.

THE peculiar physiography of the South American continent is such that practical aviation is of far greater importance to its people than to us. Their mountain ranges are more lofty and extensive than our own and the interior includes an immense, high plateau region. In Peru this plateau is cut by many canyons too wide to bridge, and so deep that in four cases a descent of more than 5500 feet must be made before climbing up the other side. In other sections are enormous forests, jungles annually inundated for hundreds of square miles, and extensive regions inhabited only by wild beasts, snakes, and sometimes by tribes of savage Indians.

The Spaniards in South America, unsurpassed in boldness and hardihood by those of any other time or race, were not content with founding cities along the coast. They explored and made settlements in the very heart of the continent. But they were followed by no swarms of immigrants, such as helped to populate our coasts and our more friendly hinterland. Confronted by almost insurmountable natural barriers, anything approaching an adequate system of transportation has been for them impossible, save over the broad pampas of Argentina and in Uruguay, where British capital long ago came to their aid. It was the countries with more difficult topography that earlier turned to regular aviation service; first there was Colombia, and then came Bolivia, followed by Peru, Chile, and Brazil.

Bogota, capital and chief city of Colombia, lies on a plateau 8650 feet above the sea, 700 miles from the northern coast, and 350 miles from the Pacific. From the west, two mountain ranges must be crossed, the first by rail, the second by motor road


Routes in operation
Under mail contract and in course of organization
Routes under survey
TEXAS
FLORIDA
BROWNSVILLE
GULF OF MEXICO
MIAMI
NASSAU
TAMPICO
TUXPAN
MEXICO CITY
VERA CRUZ
MINATITLAN
VILLA HERMOSA
CAMPECHE
MERIDA
HABANA
LA FE
CUBA
CAMAGUEY
WEST INDIES
ISLE OF PINES
SANTIAGO
PORT AU PRINCE
SAN JUAN
HAITI
SANTO DOMINGO
GUADELOUPE
MARTINIQUE
PUERTO MORELOS
CARMEN
TUXTLA
PUERTO BARRIOS
BELIZE
TELA
TAPACHULA
GUATEMALA CITY
TEGUCIGALPA
GRACIAS A DIOS
SAN SALVADOR
MANAGUA
CENTRAL AMERICA
PUNTARENAS
SAN JOSE
PORT LIMON
DAVID
CRISTOBAL
CARIBBEAN SEA
BARRANQUILLA
CARTAGENA
CURACAO
MARACAY
MARACAIBO
PORT OF SPAIN
ATLANTIC OCEAN
TURBO
JURADO
BUENAVENTURA
GEORGETOWN
PARAMARIBO
CAYENNE
TUMACO
ESMERALDAS
BAHIA DE CARAQUES
GUAYAQUIL
PARA
MARANHAO
TALARA
PACIFIC OCEAN
SOUTH AMERICA
NATAL
TRUJILLO
PERNAMBUCO
LIMA
ICA
LOMAS
MOLLENDO
ARICA
BAHIA
IQUIQUE
ANTOFAGASTA
VICTORIA
CALDERA
RIO DE JANEIRO
SANTOS
SERENA
COQUIMBO
SAN JUAN
CORDOBA
VALPARAISO
SANTIAGO
ROSARIO
BUENOS AIRES
MONTEVIDEO
SCALE IN MILES
0
100
500
1000

SOME OF THE AIRWAYS TO AND IN OUR SISTER CONTINENT

and bridle path over a pass 10,000 feet above the sea. The usual route is from the north, up the Magdalena River, 1000 miles long, but because of shoals and shifting channels, the passage may be impracticable for weeks. Under favorable conditions the trip can be made in 10 days.

While Americans were thinking more of feats like the transatlantic passage, Colombians formed the Sociedad Colombo Alemana de Transportes Aereos, called Scadta. With German planes and aviators a weekly service was installed in December, 1919, from Barranquilla, an important city near the mouth of the Magdalena River, 622 miles up the valley to Girardot.

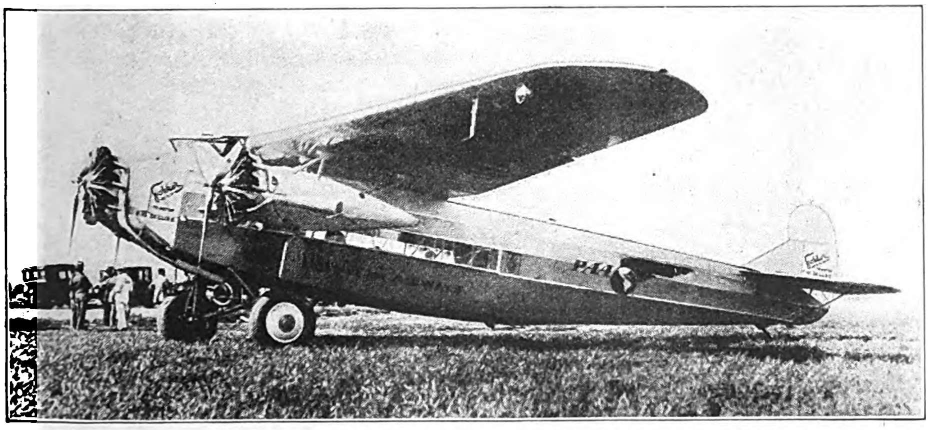
THE all-metal Junkers seaplanes now give mail and passenger service daily except Sunday, when freight is carried. At Calamar travelers who have come by rail from the famous old city of Cartagena are taken on. At Puerto Wilches connection is made by land plane, three times a week, with Bucaramanga, capital of the Department of Santander. Barranca Bermeja, the next halt, is interesting to Americans as the river port of the oil wells near by, operated by the Standard Oil Company of New Jersey. A stop is made at Puerto Berrio, notable as the river port of the enterprising and wealthy city of Medellin, a center of trade in coffee, gold, and manufacturing industries. The 10-hour air journey terminating at Girardot may be followed next day by a seven-hour trip by rail to Bogota. Once a week a plane makes a round-trip flight from Girardot to Neiva, at the head of navigation on the river. It is noteworthy that Colombia's airplane service, receiving no subsidy from the government, has been profitable from the beginning and gradually extended.

Twice a week flights are made from Barranquilla to Santa Marta and return, there connecting with the United Fruit Company's steamers making the quickest time to the United States. A five-hour flight is made each Thursday from Barranquilla to Cartagena, Sautata, Quibdo, Istmina, and Buenaventura. At Sautata this plane is met by a Scadta plane from Colon from which passengers may be transferred for the journey south to Guayaquil. On Friday, a seaplane continues down the western coast, calling at the ports of Tumaco, Esmeraldas, Bahia de Caraques, Sta. Elena, and Guayaquil, the port for Quito, capital of Ecuador. Permission to continue from Guayaquil to Talara or Paita is hoped for.

At the moment, Venezuela has only a government military service to all of its principal cities, with headquarters and an aviation school at Maracay. Civil service is under consideration. British Guiana has an airplane used by officials and for carrying mail, and occasionally for ambulance service from the diamond fields. In French Guiana a seaplane is sometimes employed between Cayenne and St. Laurent.

Bolivia in 1925 inaugurated air service for mail and passengers between Cochabamba and Santa Cruz. The air line distance is 250 miles and is covered in three hours, the planes soaring to a height of 15,000 feet. This air trip, which formerly took 10 days on horseback, has been enjoyed by a lady over 70 and by an infant of three weeks.

The Bolivian Lloyd Aereo, with Junkers metal seaplanes and land planes, has more recently installed monthly service from Santa Cruz to Puerto Suarez on the Paraguay River nearly 500 miles east, and another southward about 350 miles to Yacuiba, on the border of Argentina. A longer journey is made twice a month from Cochabamba north to Trinidad, Guay-



AN AIR PULLMAN ON AN INTERNATIONAL AIRLINE
One of the luxurious tri-motored planes used by the Pan American Airways, Inc., in their air service from Miami to Havana. Twelve passengers and a crew of three are carried

Photograph courtesy *Chile*

AT "EL BOSQUE"

Planes of the Chilean army are shown here flying in formation over the recently dedicated landing field

aramerin on the Madeira, Mamore Railway, and to Riberalta. A seaplane is used from Todos Santos to Trinidad and beyond, where rivers are followed. Here the airplane performs a wonderful service to settlements situated in an immense wilderness.

Peru, after some experimenting, has inaugurated regular air service. The Peruvian Airways Corporation, a W. R. Grace and Company organization, began in 1928 to operate along the Pacific coast from Mollendo to Guayaquil. Now controlled by the Pan American-Grace Airways Inc., this line is operated in connection with the through service from the United States inaugurated in May. Calls below Guayaquil include Talara, the oil port for the International Petroleum Company, and the important cities of Trujillo, Lima, and Mollendo.

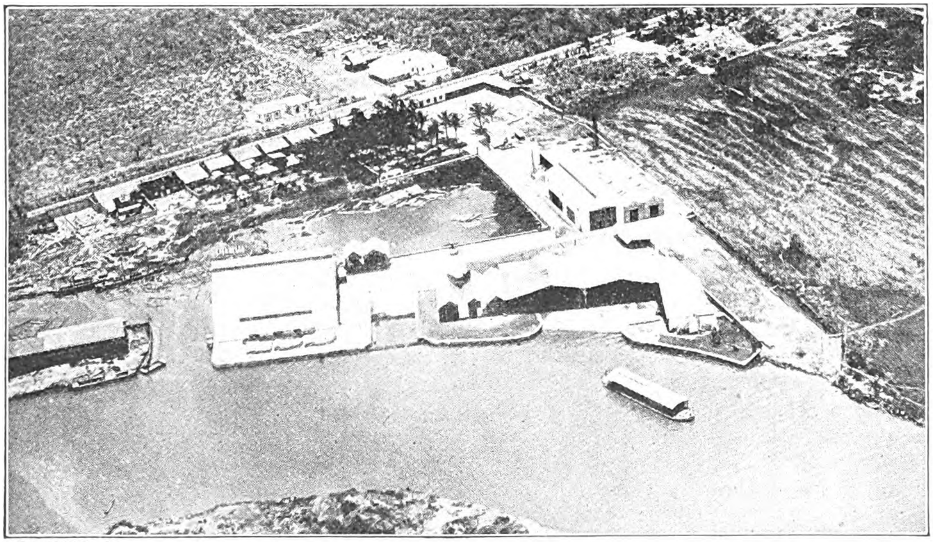
A service of very great value, although not entirely by air, is from Lima to Iquitos on the Amazon. Formerly it was a journey of about 15 days by rail, motor, horseback, and river boat. The only alternative route was to sail by way of Panama to Para, Brazil, and then 2300 miles up the Amazon River to Iquitos. The first airplane journey by passengers over the direct route was made by a gentleman and his daughter as a pleasure trip. They found the flight by seaplane from Iquitos to Masisea so agreeable that they decided to proceed by land plane, arriving at five the same afternoon at San Ramon in the beautiful Chanchamayo Valley. The next morning they rode by motor car up to Oroya, thence across the Andes by train to Lima, where they arrived in less than 36 hours from Iquitos; a striking illustration of the usefulness of airplanes in South America.

Chile is also interested in developing rapid communication by air, although, unlike Peru, it has no urgent need to reach a remote interior. Few parts of the country are much more than 100 miles from the coast. A daily service by the Latecoere Company is in operation between Santiago and Valparaiso, so that mail may be sent to the port on the day of steamer sailing or be received in Santiago on the day the boat arrives.

ARGENTINA has had a German service, occasionally suspended, from Buenos Aires to Montevideo; but now there is daily service shared by three companies, German, French, and Argentine.

In addition to the weekly service from Europe, Brazil now operates one of its own through the Condor Syndicate, Ltd. At first weekly but now twice a week, Dornier and Junkers seaplanes go south from Rio de Janeiro, calling at the famed coffee port of Santos, and at Paranagua, terminus of the railway from Curityba, capital of Parana. Other calls are made at São Francisco, Florianopolis, and Porto Alegre. There is continuation service to Pelotas and Rio Grande. This air journey from Rio to Porto Alegre is made in one day instead of the five required by boat or train. From Rio to São Paulo a daily service is in operation, with a weight allowance, including baggage, of 167 pounds.

The weekly French air service from Europe to South America has been operating since March 1928 from Toulouse to Buenos Aires, covering the one way trip in eight or nine days. The route followed is from Toulouse, France, to Casablanca, Morocco, 1147 miles in 13 hours; then to St. Louis, Senegal, 1767 miles in one and one half days. Changing to seaplane, the

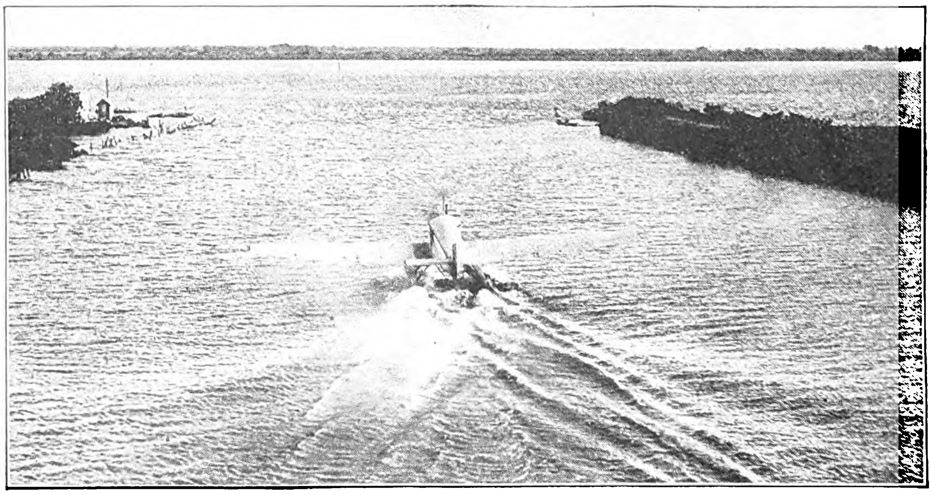


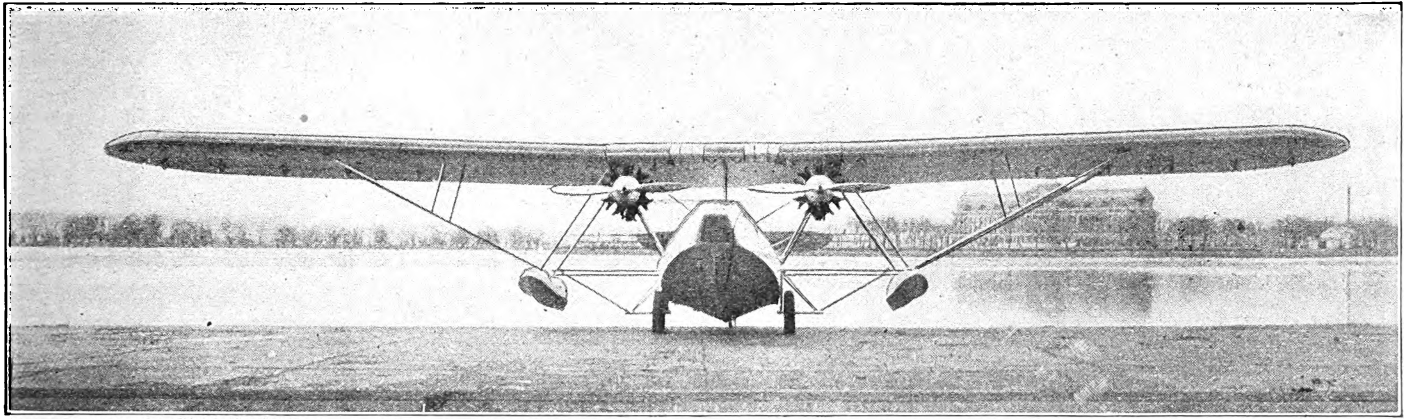
Copyright Scadta

AIR-SEAPORT

At the left and below are two views of the seaplane base at Barranquilla, Colombia

Copyright Scadta

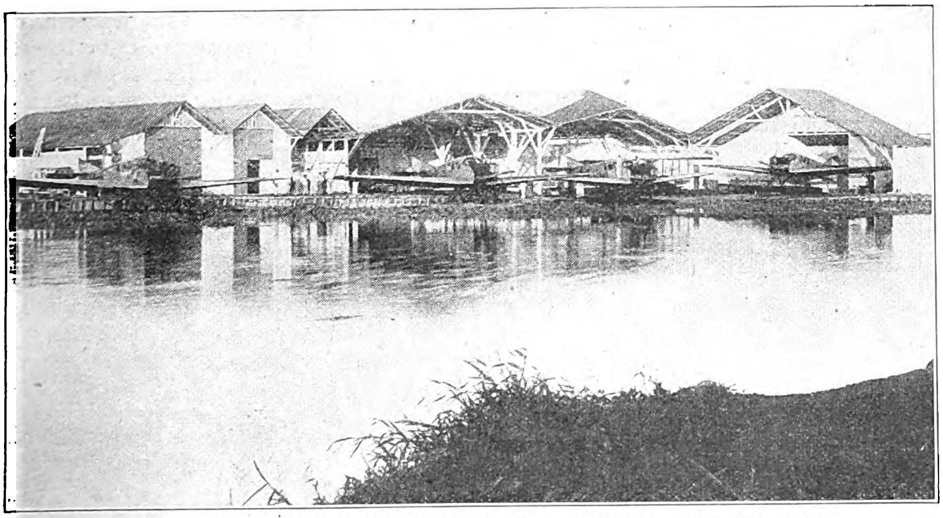




Photograph courtesy Consolidated Aircraft Corp.

ONE OF THE TWENTY-PASSENGER "COMMODORE" AMPHIBIANS USED BY NEW YORK, RIO AND BUENOS AIRES LINES, INC.

journey continues to Cape Verde, 402 miles in five hours. From Cape Verde the mail is taken by steamer to Isla Fernando da Noronha, a rocky islet belonging to Brazil, 1364 miles in three days. Seaplane service is then resumed. After a five-hour flight, Natal is reached. The remaining 1200-mile flight to Rio de Janeiro occupies 14 hours, including calls at Pernambuco, Maceio, Bahia, Caravellas, and Victoria. The journey to Buenos Aires requires 15 hours, with intermediate calls at Santos, Florianopolis, Porto Alegre, Pelotas, and Montevideo. Chile is served by rail in 36 hours more, but it is planned to extend the air-mail route over the Andes, it is said, to Copiapo. There is now airplane connection with Asuncion, Paraguay.



A CLOSE-UP OF THE HANGARS AT BARRANQUILLA'S AIR-SEAPORT

The new service of the Pan American Airways from Miami to Cristobal, and of the Pan American-Grace Airways from Cristobal to Mollendo, with early extension to Santiago, is a most welcome addition to local operations. An amicable arrangement was made with Colombia by the signing of a treaty which permits Scadta ships to land at Colon, and United States planes to land in Colombia. Expert pilots have been engaged for the service. Sikorsky amphibion planes are used as far as Guayaquil or Talara and land planes beyond.

The route followed by the Pan American line is from Miami to Havana, Cuba, with a call at the fuel station La Fe, at the western corner of the island; then to Puerto Morelos in Yucatan, where United States western mail will be received from Brownsville, Texas, by way of Tampico, Vera Cruz, Merida, and other Mexican cities. This service is performed by the Compania Mexicana de Aviacion, controlled by the Pan American Airways. From Puerto Morelos, the Miami service continues in two days to Belize, Tela, Managua, Puntarenas, David, and Cristobal. From Cristobal south, service is by the Pan American-Grace Airways, Inc.

The first call in South America is at Jurado, for fuel; the second at Buenaventura. The next day calls are made at Tumaco, Esmeraldas, Bahia de Caraquez and Guayaquil. One day serves for calls in Peru at Talara, Trujillo, and Lima; another day for Ica, Lomas, and Mollendo, or beyond to Arica in Chile. Iquique, Antofagasta, Caldera, Serena, and Santiago will be served in two days more. Within the year, service may be continued over the Andes to San Juan, Cordoba, Rosario, Buenos Aires, and Montevideo, this route to Buenos Aires being shorter than by the east coast.

A Pan American Airways service now extends from Miami to Nassau; a second to Camaguey and Santiago de Cuba, to Port au Prince, (Haiti), and to Santo Domingo and San Juan (Porto Rico). This service may be extended to Guadeloupe, Martinique, and Port of Spain. Another may be arranged from Cristobal by way of Turbo, Cartagena, and Barranquilla to Maracaibo, Curaçao, Maracay, Port of Spain, and beyond to Georgetown, Maramaribo, and possibly to Para, Maranhão, Natal, and Pernambuco.

AT the time of writing, weekly service from Montreal to Miami is being instituted by the Pan American Airways. In July it is expected to make this twice weekly. Thus 8000 miles may be covered by air from Canada to points in South America.

The New York, Rio and Buenos Aires Line, Inc., has planned the following service: First day, New York to Miami, with calls at Baltimore, Washington, Norfolk, Wilmington (North Carolina), Charleston, Savannah, Jacksonville; second day, to Port au Prince, (Haiti), with calls at Havana, Cienfuegos, Camaguey, Santiago; third day, to Port of Spain, (Trinidad), calling at Santo Domingo, (Porto Rico), Basse Terre (Guadeloupe), Fort de France (Martinique); a branch line from Trinidad to Caracas; fourth day, to Para, (Brazil), with calls at Georgetown, Paramaribo, and Cayenne in the Guianas; fifth day, calls at São Luis de Maranhão, Fortaleza, Natal, Pernambuco; sixth day, Maceio, Aracaju, Bahia, Caravellas, Victoria, São João de Barra, and Rio de Janeiro; seventh day, Santos, Paranagua, Porto Alegre, Pelotas, Montevideo, and Buenos Aires. Eight Sikorsky planes, each accommodating eight passengers have been ordered, and six Commodores, accommodating 20. Service beginning in August is expected to be weekly before the end of the year—a very ambitious program.

Foiling the Burglar

From Time Immemorial Man Has Tried to Protect His Worldly Goods From the Hands of the Despoiler

By ALBERT A. HOPKINS

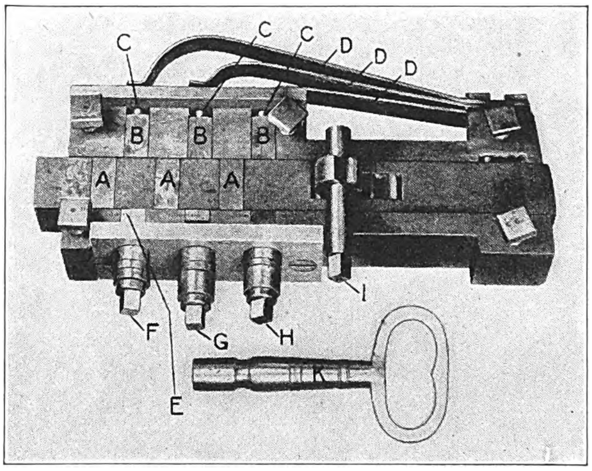
Author of "The Lure of the Lock"

PEOPLE have been protecting their possessions for thousands of years, and Biblical references are numerous. The locks were crude and cumbersome, but they evidently kept the thief at bay most of the time. In the middle ages the château locks were massive and ornate, and gave little protection. It was in England that the modern lock had its inception. The Bramah and the Chubb locks were famous and a considerable part of the strong boxes of the world are still protected by Chubb lever tumblers. The locks of the United States are one of the glories of American invention. The names of Yale, Sargent, and Towne are in the front rank of the inventors of America, and their products are in use in every country of the world, civilized and uncivilized. Not far from that busy strand of life, Fifth Avenue, New York, is a little-visited collection of locks. It is our privilege to illustrate some of the locks from the J. M. Mossman collection in the museum of the General Society of Mechanics and Tradesmen at 18 West 44th Street, where they are gladly shown.

WHEN we are dealing with locks, strange to say, the word "key" means nothing in particular. It may be a little piece of metal with holes drilled in it; it may mean a pocketful of washers, or numbers or letters which, through proper mechanism, serve to release the bolt. We hear of "burglar-proof" safes and vaults being cracked, and "fireproof" safes being burned up and their contents destroyed. These terms are merely relative and mean that at the time the safes or vaults were built they resisted burglars and fire most of the time. Now we can build vaults which are impregnable both to fire and the yeggman. It took more than a century, however, to evolve the perfect protection, which is very costly. A banker now finds that it pays better to put 50,000 dollars in a vault than to have perhaps 200,000 dollars stolen. While money can be insured, there is more satisfaction in conserving it than losing it.

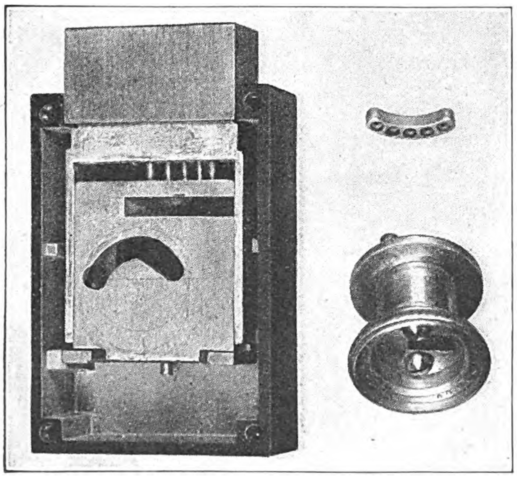
Burglary is one of the poorest paid of the learned professions. Warden Lawes, of Sing Sing, shows that the average receipts from a haul are $43.22, while forgery pays better, 5,870 dollars being the average net proceeds. Seventy-one percent of the burglaries are futile. Not a very going business, is it? Some writers and moving picture directors picture crooks as lovable, generous to a degree, always ready to "kick in" with their fellows, and never squealing on a pal. As a matter of fact, they are cruel, always ready to "gyp" their mates of their share of the spoils, and always ready to save their own hide at any cost. "Honor among thieves" is a *rara avis*. Burglary will soon be as lost an art as wood-engraving. The hold-up man is running very strong at the present time. Neither the skill of the cracksman nor his patience is required in this brutal game of "stand and deliver." It is a sad commentary on the times when our streets are filled with armored cars, and money can only be transferred with the finger on the trigger.

THE movies do a lot for the rehabilitation of the crook, probably without intending to do so. You see the burglar listening to the turning tumbler and presto—the bolts will be undogged; but alas, there is no "Jimmy Valentine." In order that this matter might be disposed of once for all, the writer consulted a great lock expert who said: "In answer to the question, 'Can anyone pick or manipulate open a good combination lock when properly applied?' I would say 'Perhaps, yes, but unfortunately, the real Jimmy Valentine is always out of reach. He seems to live on the



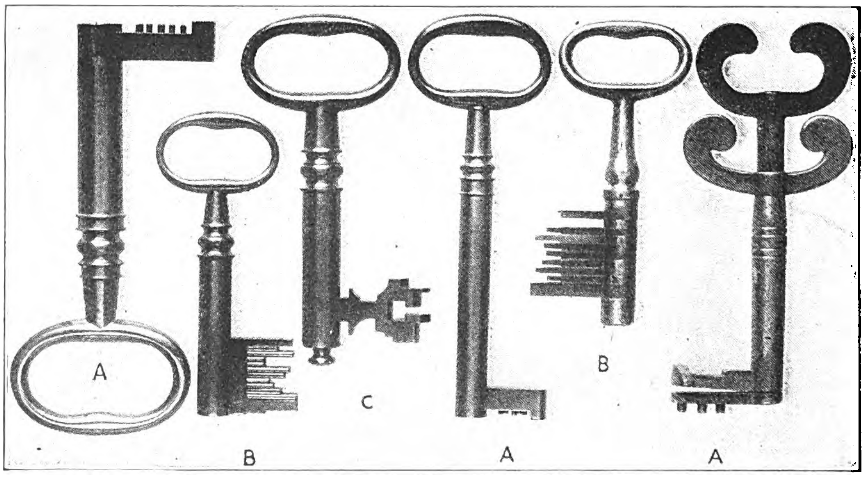
PERKINS LOCK OF 1813

This ponderous lock was beautifully designed. The "keys" were the washers, which allowed the bolt to move



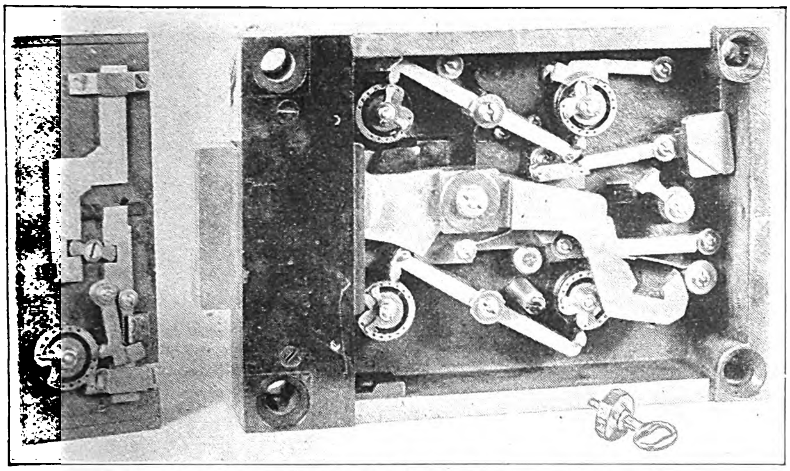
OLD YALE PIN LOCK

The key is the brass segment which is inserted in the knob and is then automatically ejected

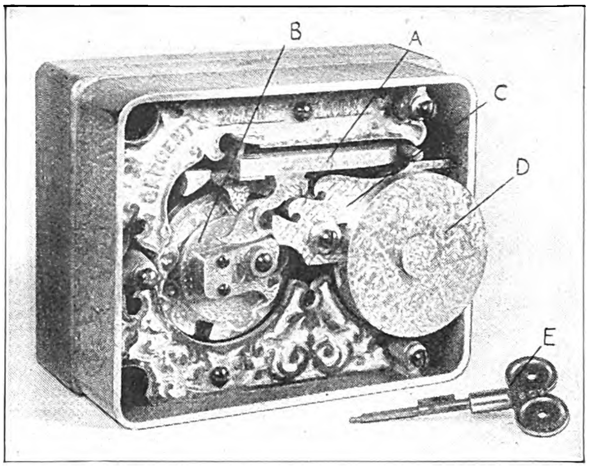


WHEN KEYS WERE KEYS

Some of the keys (A) have removable pins, others (B) have removable tumbler lifters, or "bittings," still others (C) had plugs to keep out dirt. These keys are all of large size



BUTTERWORTH COMBINATION LOCK OF 1846
This was one of the progenitors of the combination lock. There are three "stacks" of rotary tumblers set by a key. The back locks on with a dial



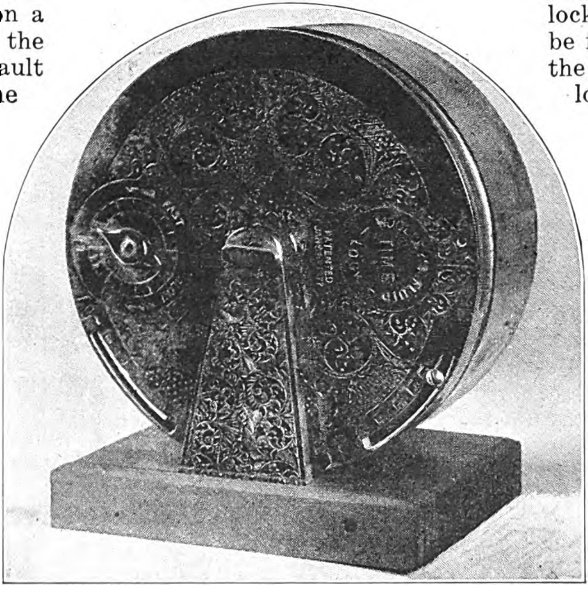
SARGENT MAGNETIC LOCK, 1866
This was a combination lock with magnets which kept mechanism out of contact until the setting was complete

desk of some scenario or story writer, and can't be found available.'

"The above is about all that I think we need say; if anyone knows better, then let him bring forth the man. I have seen 29 years of bank lock work, and have been associated with a great many people who lived back of my time, and while there are certain things that a man can learn, and a certain knowledge that we have of these devices, yet it is still true, I believe, that any good five dollar combination lock properly applied and properly set is non-pickable so far as you and I mean. If this were not true, then we are certainly wasting a lot of time and money, when, in the event of a lockout on a safe or vault door, we cut through the door, or through the side of the vault or safe to gain access and make the repairs.

"In the first place, if you put three or four wheels on a shaft, and turn one or all around, you have the average combination lock operation, so far as the tumblers are concerned. The word 'tumbler' seems to indicate to most people that something drops down, and in nine out of ten reports, you will find mention of the dropping of the tumblers, whereas there is nothing that drops, so far as the tumblers are concerned. The earmark of truth is not in the story. The earmark of untruth or hearsay is in nearly every one of these stories in that one set statement 'Hear the tumblers drop.' "

SOME of the earlier American locks are so extremely complicated that it is a wonder they functioned at all. Some of them, however, were very clever even in their simplicity, as the Perkins lock of 1813 which is interesting because washers are the keys. Three channels are milled out of the bolt proper which are normally filled with blocks A. Movable blocks B terminate in pins C which are held in contact with the bolt proper by powerful leaf springs, D. At F, G, and H will be noticed studs having square heads. On these studs will be seen a series of washers which are really the "key." When the banker went home he took his washers with him. On the morrow he unscrewed the studs, placed the washers on them according to a prearranged setting, and screwed the studs home. If the setting was correct there would be nothing in the path of the blocks A, each within its slot, lining up with the bolt, and a throw of the wrench K on square head I would retract it. If a stranger should attempt to open the lock with duplicate washers what would happen would be that if the combination was wrong, one of the blocks E would force a block A into the channel occupied by block B, thereby dogging the bolt. A considerable number of combinations were possible, and the lock was used until quite recent times.

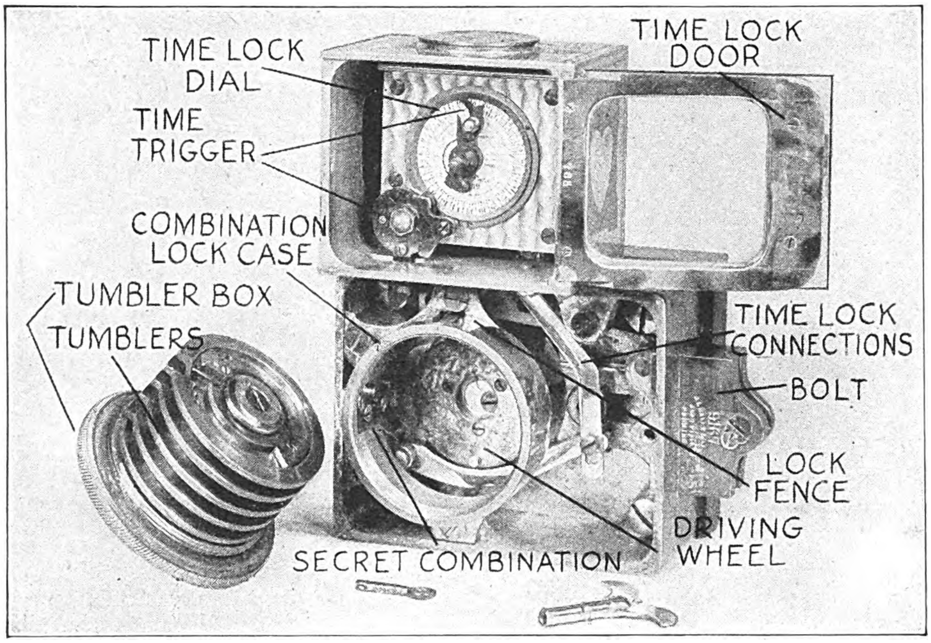


LIQUID TIME LOCK, 1877
The case is divided and liquid flows between each part until both are equal; then a weight revolves the lock

Another keyless lock was invented by the elder Linus Yale. The key is a segment of brass with holes of varying depths drilled in it. The "key" is pushed through an aperture in the knob, which is then turned. The key passes through the lock, raises the pin-tumblers and discharges itself through the knob handle after allowing the bolt to be retracted. Although this is a freak lock it was the precursor of the pin-tumbler lock.

THE Yales, father and son, invented many locks of great ingenuity which were towers of strength until the coming of the combination lock. In our illustration of keys will be found at B a type of key in which the "bitting" could be changed and the lock would set itself to operate only with the changed key so the banker could have a new combination every day if he wanted it. Keys were large and the barrels were apt to become clogged with dirt so a metal plug was used (See key C) and we find in "Pickwick"—"Mr. Lowten replugged and repocketed his Brahmah." Keys were keys in the old days and not mere slices of metal. If you carried four or five keys you had a decided list to port.

The combination lock set the burglar back for quite a space of time. With four tumblers and one hundred numbers on the dial there are 100,000,000 possible changes, all of them equally useful. Inventors worked on combination locks for a long period but the problem would seem to have been solved by J. H. Butterworth of Dover, New Jersey, who invented a cash drawer with a stack of four tumblers and a locked back on the cover. He then made locks with two, three, and four stacks of tumblers, making a very safe lock, and to crown all, he locked on the cover with a real dial and not a removable dial key with letters. We



SET A LOCK TO WATCH A LOCK

Here we have a combination and time lock with a secret combination known only to the manufacturer. In case of a "lock out" the banker telegraphed the maker for the secret combination

illustrate this beautiful piece of mechanism.

Burglars found that the combination lock could be picked by forcing the bolt back so as to get a contact with it and the edges of the wheels, by which their position was ascertained. In 1866 a prominent lock inventor and manufacturer, James Sargent, conceived the idea of using a magnet which served to hold up a lever, or dog, until the tumblers are brought into line by setting the proper combination. The lever does not rest on the wheels, nor is it brought to them by a spring, but is sustained by the magnet. Every time the knob is turned around, the magnet is separated from the lever which then falls to the wheels, and if the slots in the wheels are in line, drops into them, thus releasing the bolt. Combination locks were all right until the advent of the "masked burglar" who kidnapped and tortured the cashier and possibly his family as well. There was no let up in the eternal battle and as several bankers were murdered, the inventors tried to gain on the burglar, and give some sleep to bank officers and other custodians of funds.

At last the time-lock was evolved by which a clock or clocks were put to watch the vault, from the inside, so that neither friend nor enemy could open until the appointed time. The time-lock still remains the great bulwark after the first line of defense, the vault itself. The evolution of the time-lock is a long chapter in the history of invention. Bankers were skeptical about the ability of a clock to control their openings, but the masked burglars waxed bolder and something had to be done—the time-lock was the only solution. It was soon found that the clock was likely to go the way of any clock, so it was found feasible to put in two clocks instead of one, and three clocks gave even more security.

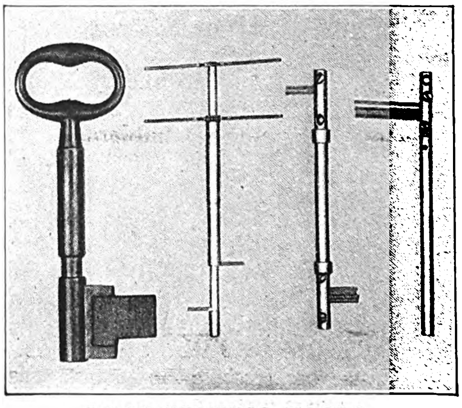
A TIME-LOCK usually has four movements, any one of which will serve to release the mechanism of the bolt-work. While we use the word "clock" we mean something between a watch and a clock, more like a chronometer. The time movements never "run down" so as to stop from an exhausted mainspring; but after the dials have reached zero, which is the unlocking point, they run on for a given time—say 30 minutes—and are then brought to a standstill by stop-works arranged for the purpose, while at the same time, the reserve maintenance power will cause the movements to run for an additional fifteen minutes before coming to a complete stop. Bolt operating motors were largely used until about 1914. These were heavy spring motors which were released by the time locks located directly above, on the inside of the vault door. As bolt work became more complicated and heavier, manual opening and closing was resorted to, and now all the time-locks do is to remove a slight but entirely adequate impediment to the free movements of the bolts.

Freak time locks were much in evidence and one of the most interesting and ingenious was invented in 1877. This was a liquid time-lock which we illustrate. The cylindrical case turns on its axis. There are two chambers formed by a transverse partition. A small orifice allowed the liquid to pass slowly from one side to the other. When the liquid in each division became level, a counterweight attached to one side of the case caused it to rotate so that one of the cells in the edge of the case came opposite the tongue of the bolt work so that the latter might be retracted from its locked position.

We illustrate another curious lock which was a combined time and combination lock, which was nothing unusual in itself, but it also contained a secret combination in case of a "lockout." This secret combination was held by the makers until an emergency arose when it was telegraphed to the bank.

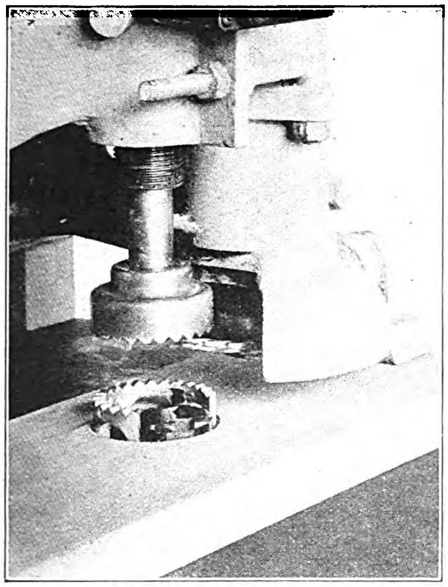
No article on burglary would be complete without some reference to "lock picking" and burglar's tools. In the middle of the last century lock picking became a great indoor sport, especially in England. "Wherever there is a keyhole, a lock can be picked." This is the dictum of a famous American inventor on whose locks the sun never sets. The element of time is as great a factor in lock picking as in vault cracking. We have seen two expert locksmiths try to pick a simple lock on the glass door of a time-lock and after they had spent more than half an hour with their picklocks give it up in disgust. Lock picking tools depend on the principle that whenever the parts of a lock come in contact with the key they are affected by any pressure applied to the bolt, or to that portion of the lock by which the bolt is withdrawn. Wherever these points of resistance to the withdrawal of the bolt can be determined, such a lock can be picked. Our illustration shows tools used by legitimate openers of safes and locks and which would be equally useful to the professional burglar.

Burglars in the late seventies carried around an immense quantity of tools. If they were discovered they usually left behind them implements costing nearly 2000 dollars. The tools were made by expert mechanics whose labor was probably very expensive as they had a "corner" on their underworld products. A motor truck would have been most convenient for the old-time burglar.



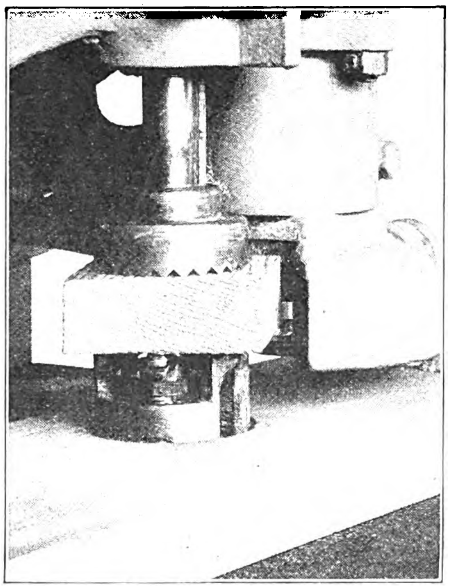
LOCK PICKING TOOLS

Blank for obtaining a wax impression and movable picklocks for raising tumblers



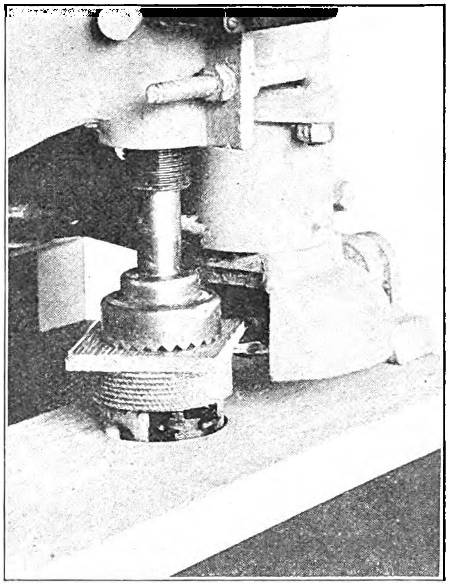
THE KNOT IS NOT

The lower spindle has cut out the knot and threaded the hole for receiving the plug



THE PLUG-TO-BE

A block of wood is placed on the projecting lower spindle and held by the upper one



THE PLUG IS CUT

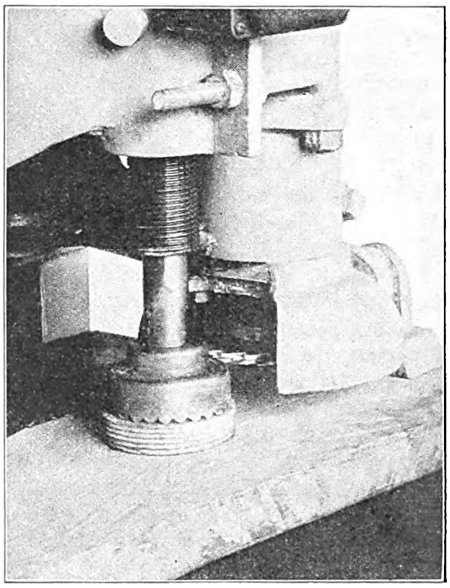
As the spindles rotate and move downward, a stationary tool threads the plug

Plugging Knot Holes to Salvage Lumber

KNOT holes constitute an ever-present and costly problem to builders and to shippers of boxed goods. In the lumber industry, knotty lumber is frequently regarded as practically useless for most purposes and can be sold only for cheap construction work such as fences, small packing cases, et cetera. Shippers sometimes cover knot holes with patches of tin. These makeshift repairs serve to prevent the knot from falling out and thus allowing leakage of the contents of the package, but the edges of the tin are dangerous to freight handlers.

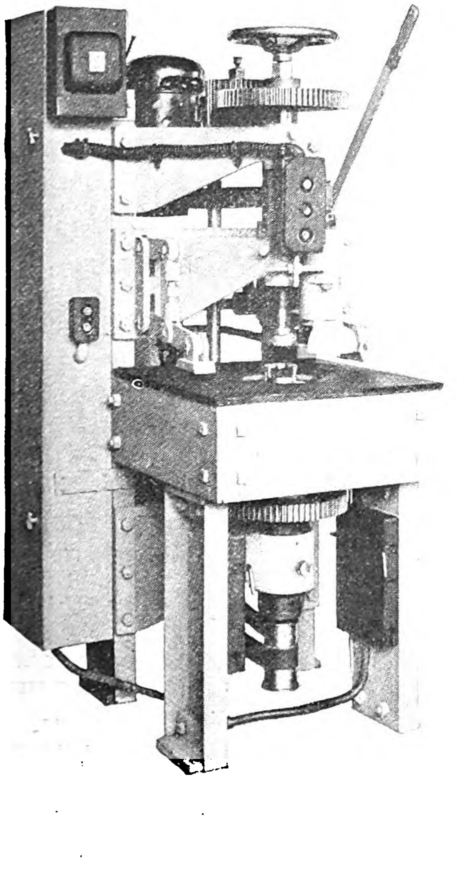
A machine placed on the market by a western concern removes knot holes from lumber and inserts a wooden plug which, after being dressed and painted, cannot be seen. The machine is electrically driven, has push-button control, and is so simple in operation that a novice can remove and plug 60 to 90 knots an hour. Knots or knot holes can be removed from either soft or hard wood of any thickness up to three inches. The wood, after being plugged, can be sawed, worked to pattern, or dressed like high-grade lumber.

THE lumber is placed on the table of the machine with the knot to be plugged directly over the vertical spindle, and clamped in that position. The spindle is started upward by pushing one of the buttons. As it moves through the wood, it cuts out the knot or knot hole and threads the cut with eight threads to the inch. A block of waste material about the same thickness as the lumber is placed on top of the spindle and held securely by a top spindle. The teeth on the two spindles hold this material so that, when the spindles are rotated, the stationary cutter attached to the frame of the machine bites into the block and cuts threads into it at the rate of eight to the inch. As the spindles continue to rotate, the plug is screwed firmly down into the lumber.



THE PLUG GOES HOME

As the spindles continue downward, the plug is screwed in place in the lumber

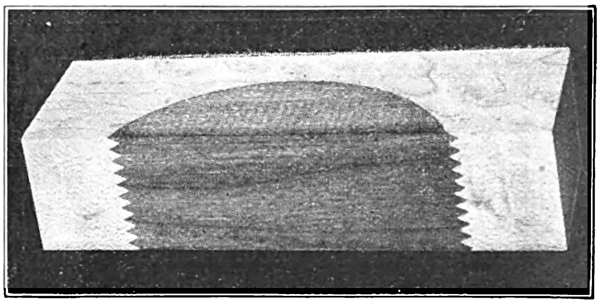


< LUMBER SALVAGER

The machine which cuts out knots and knotholes and inserts into the bored and threaded hole a plug that, when once dressed and painted, is said to be indistinguishable

A TIGHT FIT >

A thick piece of maple into which has been inserted a plug of black walnut. It will be noted that the threads interlock perfectly so that the piece may be machined without splintering



Banditry By Mail

Medical Fakers Fleece the American Public of Millions of Dollars Annually Through the Mails

By S. R. WINTERS

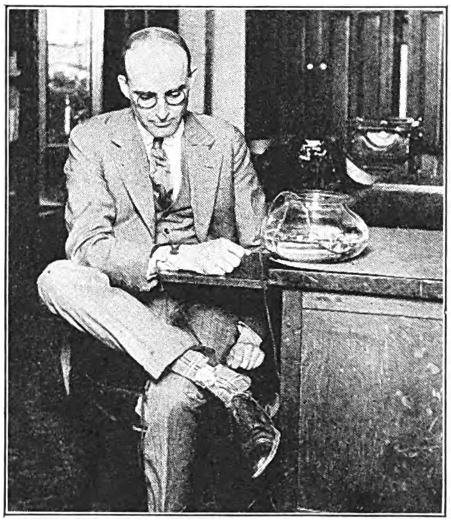
BY means of an iron ring, a muslin handkerchief, common sheep dip, and similar fraudulent schemes, medical fakers exact an annual toll of millions from the gullible American public. The Post Office Department denies many of these the use of the mails, but all of them are not apprehended.

"Long distance bandits" who depend upon the mails for the dissemination of advertisements and literature are divided into two classes; those who deliberately misrepresent, knowing their remedies to be worthless, and those woefully ignorant, who think they have made a wonderful discovery. But, the fountain of youth has not been discovered, and it is not apt to be, in a box of pills. Medical science has not discovered a drug cure for cancer, tuberculosis, and many of the diseases these fakers "cure" with ease.

THE Post Office Department makes clear to the public that: "The reliability of any person, firm, or corporation is not passed on by the department, and the department is not a collection agency and does not undertake to effect the return of any money which may have been lost in unsatisfactory business transactions; but, the Post Office Department does seek to prevent the use of mails in all schemes to defraud, and the Postmaster General may, upon evidence satisfactory to him that any person or company is conducting a scheme for obtaining money through the mails by means of false or fraudulent pretenses, representations, and promises, direct that all mails for this person or company be stamped Fraudulent and returned to the sender. The penalty for using the mails in schemes to defraud is, upon conviction, a fine up to 1000 dollars or imprisonment up to five years (one or both), and every letter mailed in pursuance of this scheme is considered a separate offence."

An investigation is instigated by Postal Inspector D. F. Angier, of Chief Post Office Inspector Grant B. Miller's Office, whose duty is to show that the mails were used for fraudulent purposes, and collect the necessary evidence in co-operation with the Bureau of Chemistry, Department of Agriculture, where these so-called "aids to health" are analyzed. Consideration of the evidence, the conduct of hearings, and the determination of whether or not a fraud order should be issued, is under the direction of the solicitor of the Post Office Department. Final action is taken by the Postmaster General.

The "testimonial-giver" is the greatest ally of the medical mountebank. He hastens to report a "cure" as soon as he feels the effect of the laxative or the tonic most of these remedies contain. The following endorsement quoted from a pamphlet issued by the "Publicity and Educational Department" of "The Oxypathor Company" is but one instance where the trusting nature of a mother in Ontario, Canada, aided the sale of a worthless device fashioned of nickel-plated gas pipe:



"OXYPATHOR"

The "polarizer" (nickel-plated gas pipe) is in the water in the bowl at the right

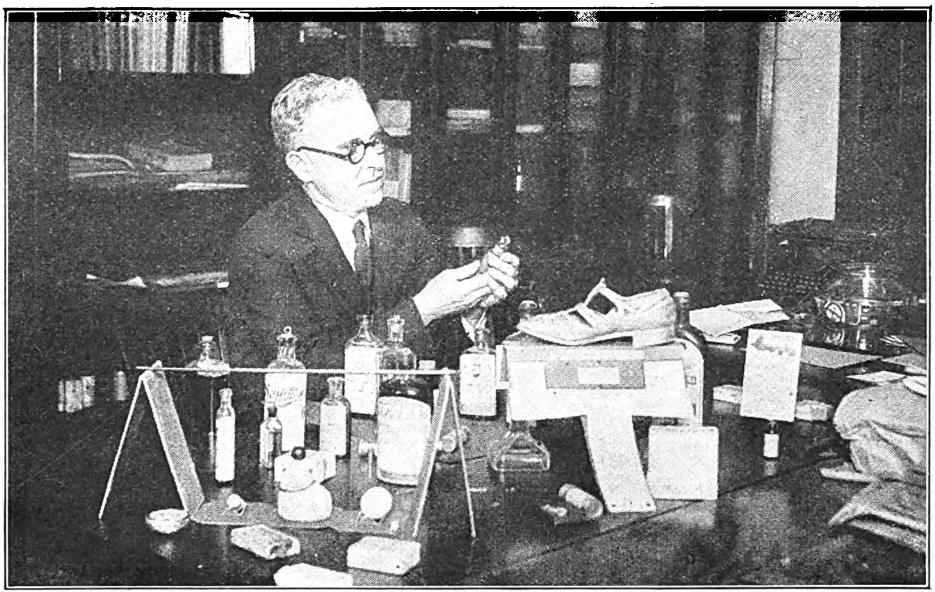
> "Gentlemen:
>
> "Our little boy, William Eric, took sick and became delirious. We called two doctors who pronounced it a bad case of spinal meningitis. He was in a terrible condition—his mouth so swollen it was almost closed, and burnt black with the terrible fever, while his head was drawn back. The doctors showed their absolute helplessness to do anything for him. They administered sleeping drops and told us it was only a question of a short time as the fever would burn him up.
>
> "At this stage, when we had given up all hope, our neighbor suggested trying an Oxypathor. She seemed so confident that we telephoned your representative who had one along in short order. We stopped giving the sleeping drops, applied the machine and in three hours we could see a change. Within 18 hours his temperature dropped from 105 to 102½ and he was sleeping naturally—from that time on he improved rapidly—the Oxypathor gets the credit for saving his life, as he never has had one drop of medicine since the machine was first applied."

According to the advertisements of The Oxypathor Company, the instrument consisted of three parts; the polarizer; the treating plates with suitable bands by which contact was made with the body; and two cords or wire cables connecting the polarizer with the treating plates. Upon investigation, it was established that this "Oxypathor" was made of a nickel-plated gas pipe filled with inert material (sand, clay, charcoal, et cetera) and having flexible cords attached.

Not only were hundreds of thousands of these instruments sold in India, Spain, Egypt, Africa, and America, for the cure of Asiatic cholera, cerebro-spinal meningitis, rheumatism, and every other human ailment, but they were also made with wider "contact" bands for animal "cure." However, no provision was made for keeping the horse, dog, cow, pig, or other animal in a fixed position by a bowl or stream of water (in which the "Oxypathor" need be submerged) long enough to insure the instrument's work. A picture illustrating the "Animal Oxypathor" in service, shows a horse tranquilly standing by a brook, with one band strapped around his body, and another strapped around his leg—these bands connected by wire with the "Oxypathor" which is in the brook.

COSTING about $1.23, the "Oxypathor" sold for 35 dollars, while the "Animal Oxypathor," which cost probably 20 cents more, since the band must be long enough to encircle the animal's body, sold for 50 dollars. The Post Office Department issued a fraud order against the company putting out these instruments, and a fine as well as a prison term was imposed.

John F. and Kate A. Braun have each served a term of three years for selling "Blessed Handkerchiefs." Under the name of Reverend D. R. Schiller, Braun endorsed the divine healing power of his wife, Kate Braun, alias Hulda De Muth. In lieu of personal treatment, these handkerchiefs (which were unhemmed squares of muslin, costing probably 3 cents) were mailed to sufferers, and a fee of 5 dollars to 15 dollars charged. The patient was instructed to "place the handkerchief over the part of the body affected, and rest in a reclining posture." Beyond this, the directions were not clear, and the length of time necessary to effect the cure was not stated.



All photos Harris and Ewing

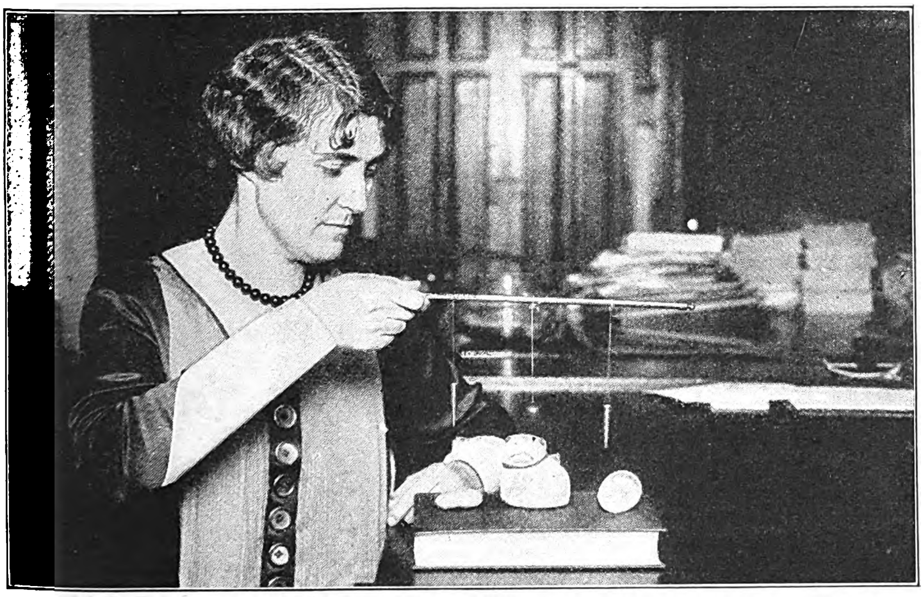
UNCLE SAM'S FRAUD DETECTOR

Postal Inspector D. F. Angier, who is directly in charge of fraud investigations. On the desk in front of him is a variegated collection of products under suspicion of being frauds

IMBUED with the "get rich quick" idea, a comparatively poor pharmacist in Kansas City, Missouri, amassed 1,275,000 dollars in four years by selling the "fountain of youth" in the form of "Genuine Melton Korex Compound Tablets." These tablets retailed for two dollars a box and enabled their distributor to build a 70,000 dollar home and spend over 40,000 dollars for furnishings. When the Postal Inspector investigated this case, he found the pharmacist held in high esteem, being a deacon in one of Kansas City's largest churches and director in a national bank of that city. At the trial of this faker, his counsel introduced a man of 74, who attested that after taking a box of these tablets he was rejuvenated, mentally and physically, to so great an extent that he was only 37 years of age! Ironical as it may seem, this witness dropped dead of old age not six months after his testimony was taken, and his "rejuvenator" sentenced to serve a well-deserved term in prison.

A small wooden ball or arrowhead attached to a string and endowed with the appealing name of "Sex Indicator" sold like wildfire. "Hold this instrument over any object—if the indicator (ball or arrowhead) describes a circle, the male sex is indicated. If the indicator moves in a horizontal line, the object is female. Of particular value is the indicator in determining the sex of lima beans. It is a well known fact that female beans are preferable, and this little instrument is especially valuable to the farmer who may establish the sex of these beans before planting"—stated an advertisement of one of the manufacturers of "Sex Indicators." If this were true, they would undoubtedly be a great help to the student, in determining the gender of French nouns! However, the Post Office Department issued a fraud order against several of the manufacturers of these instruments because they would not do what was claimed.

"Look! See what comes through your feet," commanded an advertisement of "Psycosulphene." This powder, which was found to be composed of sodium bicarbonate, borax, sulfur, and starch, was intended to rid the body of all ills by application to the inside of the shoe. Over 60,000 dollars was realized by the manufacturer before the Post Office Department issued a fraud order against him and stopped the sale of "Psycosulphene."



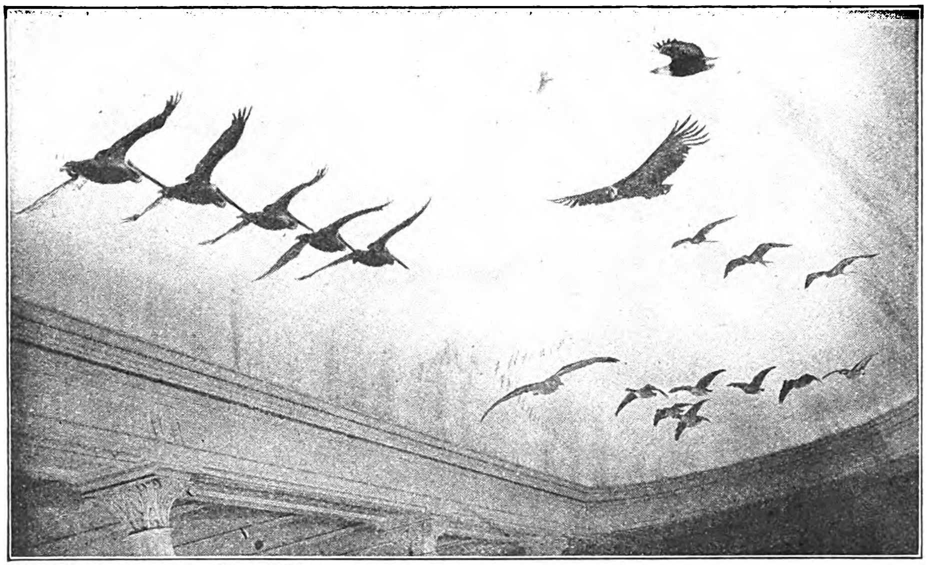
CAN THESE THINGS INDICATE SEX?

Three different kinds of "sex indicators" being demonstrated by a post office clerk. They are supposed to indicate the sex of any object whatsoever, whether it is alive or dead

BY putting two drops of Prof. Samuels' Eye Water in each eye, four times a day, all diseases of the human body were "actually cured." Prof. Samuels is said to have taken in over 1,000,000 dollars during the short time he operated, thanks to 90 percent hydrant water, 5 percent salt and 5 percent sugar—of which his "Eye Water" was composed. This solution cost five cents a gallon, and 5 dollars to 25 dollars was charged for two ounces. After serving a term in prison, he is spending his declining years on the proceeds of his ill-gotten gains.

"Amasol," a concentrated solution guaranteed for pyorrhea and sore gums, brought in 48,000 dollars for its "discoverer" in one year. The mixture was common sheep dip employed for killing parasitic insects. In compiling evidence against this company, the Postal Inspector wrote to them describing his hypothetical case of pyorrhea as being so bad that he could remove his teeth from the gums, and put them back. "If your remedy will make my teeth adhere, send me a bottle C.O.D." The remedy came, and the Post Office Department immediately issued a well-merited fraud order.

The Biblical truism to the effect that the way of the transgressor is hard applies with equal emphasis to perpetrators of medical frauds as well as other evil doers. True, in some instances justice is meted out swiftly while in other cases it travels on leaden feet, but Uncle Sam's postal sleuths are ever vigilant and right is vindicated in the final analysis.



Courtesy The American Museum of Natural History

BIRDS FLYING "IN FORMATION"

Even laymen who have watched migrating flocks of birds and noted the grace and speed of their flight, know that they fly "in resonance" as shown by the groups in this exhibit

Why Not Propel Boats By Vibration?

A Study of the Vibratory Principle of Propulsion in Nature, and the Possibility of Utilizing It for Driving Water Craft

By DR. MANFRED CURRY

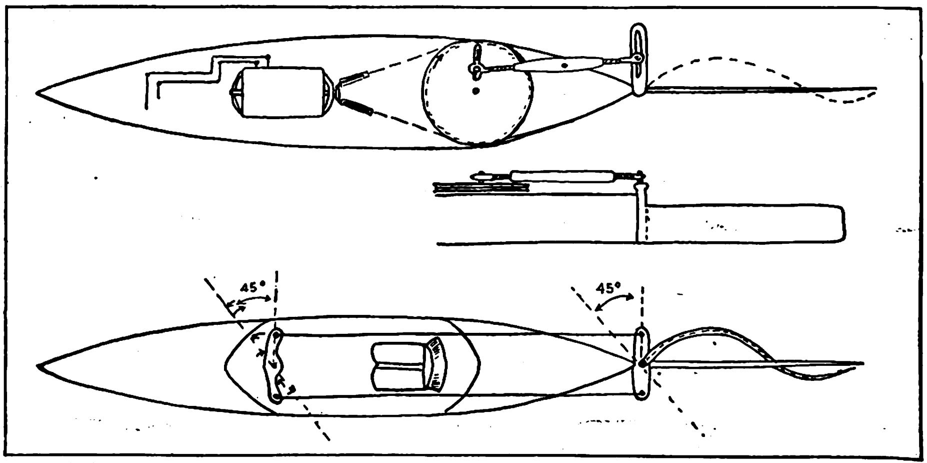
MODERN engineering makes use of the propeller as the principal driving mechanism in water and similar fluids. The vehicle, be it a boat or an airplane, receives its motion through the screw-like action of the propeller and this propulsion is dependent on the specific shape of the propeller and on the reaction which it produces in the medium, water or air respectively, in its regular motion according to the continuous flow principle. The efficiency of the screw-propeller is influenced in high degree by the ratio of the speed of the vehicle to the number of revolutions of the screw. Thus, in propelling a boat or an airplane by means of a screw, there is a wide range of inefficient action, within which range the power required is out of all proportion to the resultant speed.

In Nature we find the alternating flow principle used, in preference to the continuous flow principle, by living creatures for their propulsion in air and water. Nature, in general, goes far beyond all human conception in the fitness of her designs, and for this reason we may well assume that the method of propulsion used by birds and fishes is not accidental but was evolved on account of the very high efficiency of the vibratory principle.

Vibration not alone saves energy but it enables the individual animals to couple themselves together through resonance and to utilize the powers thus liberated in their field of excitation. Doubtless Nature could have utilized a rotary movement for the propulsion of her creatures if she had so desired. In fact, the outer edge of a bird's wing does move in circle-like paths. If Nature preferred the alternating flow principle for animals living either in air or water, this principle of propulsion must possess many advantages with reference to efficiency as well as to transmission of energy. That this assumption is true may be proved in the following manner:

LET us regard the motion of a fish and compare it with the motion of a boat propelled by means of a screw-propeller. We find, first of all, a great difference in efficiency. In the case of the screw-propeller the highest possible efficiency is about 78 percent. In the case of the vibratory action of the fish's tail, experiments made at the Technical University of Vienna, Department of Naval Construction, have shown efficiencies as high as 88 to 100 percent. This marked difference will readily be understood if we realize that the efficiency of any propelling mechanism working in any fluid is dependent on the amount of slip, or the so-called "dead water," which is produced by the motion. A rapidly turning propeller of comparatively small diameter will produce a water column of high velocity. It is impossible to prevent this quickly moving water column from being ruptured. This produces behind the screw-propeller a vacuum which cannot be filled fast enough by the on-coming water. The amount of this slip—that is, the amount of this "dead water"—is dependent on, and proportionate to, the number of revolutions and the inclination of the propeller blades and inversely proportional to the diameter of the screw.

Nature avoids these disadvantages through the use of the vibratory principles of propulsion. Nature takes care to have large and slowly moving surfaces that remain in constant touch with the fluid, so that no slip need

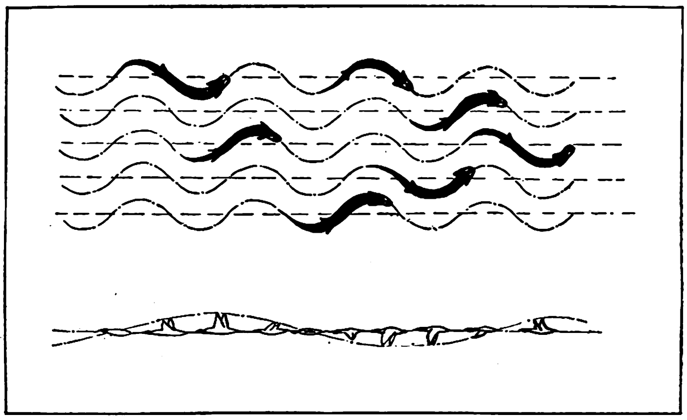


All sketches by the author

FISHTAIL BOAT-DRIVING MECHANISM

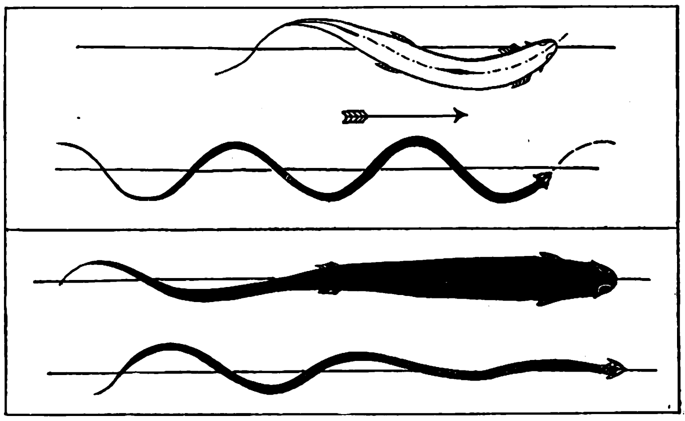
Vibrating fishtails made of tempered flexible steel attached to boats, the upper one being oscillated by an engine and the lower one by foot power, to propel the boats speedily forward occur. The fish tail shows the same characteristic for all kinds of fish. Its slow, swinging motion gives the oncoming water sufficient time to follow the pressure of the tail. The swinging of the tail produces very little motion of the surrounding water. The propelling action consists practically of a sliding on an inclined plane, the direction of which is continually changed, but the resultant axis of which lies in the direction of the desired motion. In the case of propulsion by means of a screw-propeller, the water is not only pushed backwards, but is also given a rotary movement, which latter is of no use whatsoever for the propulsion of the vehicle.

A FURTHER advantage of the swinging or vibratory motion lies in the possibility of using the resonance of vibration for connecting the swinging motions of several individuals or mechanisms. Through the oscillating movement of a fish, a vibration is produced in the fluid, the length of period and amplitude of which is dependent on the specific swing of the body of the fish. This wave moves throughout the field of excitation in the water with its specific velocity and attempts to produce vibration of the same period and amplitude in other fish bodies capable of vibration within its reach. Let us assume that such a body itself starts a swinging motion which corresponds to the exciting wave; that is, let us assume that this second body will "tune in" on this wave. Then it receives from the energy of the wave a driving motion without exerting any energy of its own. Mr. Schieferstein, well-known expert in the science of vibration, has made exceedingly interesting experiments with reference to the oscillating flight of birds, which experiments have definitely proved that it is possible for cranes flying together, to couple their energies in such a way as to carry along their weaker partners for long distances, if these weaker birds possess just enough strength to keep their wings tuned in to the exciting wave of the stronger ones.



VIBRATION AMONG FISH AND BIRDS

A school of fish and a flock of migratory birds as they appear when traveling long distances, showing their relative positions



SPEEDING AND WANDERING

Above are shown the body movements of a fish and an eel while traveling at high speed and below, their movements when roaming

A similar phenomenon can be noticed in connection with the motion of large schools of fishes. If we regard, for instance, the motion of a number of minnows, we perceive that they all continuously perform exactly the same oscillatory motions and that these motions are tuned in to the same wave period and amplitude. Thus the individual fishes help each other and distribute the total energy of the forward swing to all members of the school.

As an example of the remarkable amount of energy which can be made available through vibratory motion, there is the trout which is capable of mounting the most rapidly flowing streams and can even negotiate whirlpools and waterfalls. By means of a whip of its tail, the trout jumps from the quickly moving waters over stones and other obstructions. A mechanical vessel with screw-propeller would, if at all capable of performing such feats, require an exceedingly large amount of energy for the purpose.

The flying fish are another example of the high acceleration possible through vibratory motion. Through a whip of their tails these fishes throw themselves many feet above the surface of the ocean. It is a well-known fact that sharks and whales can attain remarkably high velocities. The speed of a whale hit by a harpoon easily exceeds the speed of the pursuing fishing steamer. Sharks and dolphins follow the modern ocean liners for days, apparently without tiring.

THE driving action of vibration can also be seen in groups of men skating in the Dutch fashion. Through the use of swinging motion these men can keep up high speeds over long distances without difficulty.

It is hardly necessary to go into detail in connection with the flight of birds, which resembles the motion of the fishes in many ways. It is well, however, to remember in this connection the fact that the almost incredible performances of half-starved wild geese and ducks in winter can only be explained through their efficient use of vibratory motion.

IT will be technically difficult and not always advisable to imitate the motions of living creatures, but the above mentioned phenomena are so striking that the modern engineer cannot pass them by unnoticed. We may call the past century the age of rotation. There are many signs which seem to indicate that the coming age will make use of vibration for propulsion in a much higher degree than has been done thus far. And in developing and perfecting the mechanism of vibration, modern engineering will have to profit by the creations of Nature, our most perfect master.

In consideration of the foregoing observations of which the German engineer, Hans Schramm, has made a special study, he has constructed an experimental boat containing a motor-driven rotary device effecting a fish-like propulsion. This is possible by means of a flexible steel plate which is moved back and forth by an attached lever, the eccentric end of which is connected with the rotating wheel by an adjustable rod.

The same effect may be accomplished by human power. The oarsman is seated and both feet are attached to a foot-rest which operates left and right on a central pivot. By alternately pressing either side of the foot-rest which is connected to a similar lever on the stern of the boat by a cable on each side, the steel plate is thrown into wavelike motion, thus effecting the same result. A speed of seven miles per hour was obtained by this boat.

¶ *Did plants and mammals, even man himself, have their beginnings in Africa? A well-known scientist says "yes" in a forthcoming article.*

Groupings in the Aviation Industry

Status at the Time of Going to Press

By ERNST and ERNST
Accountants and Auditors

AVIATION companies are merging so fast these days that it takes a score card to keep track of them. Groupings of today are realigned tomorrow. Independents this month become units of combinations next month. The year 1929 will go down in aviation history as the great initial scrambling period.

To the average man it may be useful to point out the main directions of the currents of consolidation. This must be done in a rather tentative and incomplete way, for the picture changes kaleidoscopically, and the lines of corporate influence drawing the groups together are complicated by interlocking directorates, personal affiliations of like-minded executives and other similarities of purpose, as well as by outright financial control. Subject to these qualifications, there are four main groups:

I. *United Aircraft and Transport Corp., or Boeing group.* This is often characterized as the "General Motors of the aviation industry," although other groups also may lay claim to the same designation. It was formed late in 1928, and was financed largely by the National City Co. It has the largest outstanding single issue of senior securities of any aviation company. All companies in the group are operated as a unit, although the competitive spirit is fostered to a certain extent, much as in the case of General Motors. It includes both manufacturing and operating companies, and the nucleus is the group of Boeing companies. The board of directors includes many leaders of the aviation and automobile industries. Some of the leading companies are:

Boeing Airplane and Transport Corp., whose subsidiaries are Boeing Airplane Co., manufacturers; Boeing Air Transport, Inc., which operates air-mail routes between Chicago and San Francisco; and Pacific Air Transport Co.

Pratt and Whitney Aircraft Co., manufacturers of "Wasp" and "Hornet" motors, a profitable company.

Chance Vought Corp., manufacturers. Hamilton Aero Manufacturing Co. and Hamilton Metalplane Co., manufacturers. Stout Air Lines, Inc., operating between Detroit, Chicago and Cleveland. The corporation also has an interest in the Maddux Lines.

II. *Curtiss, or Keys, group.* This represents greater diversity and larger capitalization than perhaps any other group, but it is not operated so closely as a unit, the affiliation being due rather to the ownership of stock in various enterprises by associated individuals. Most companies are operated independently, and it seems to be the policy to encourage the organization of a large number of relatively small companies, each operating in its special field. The dominant figure in the group is C. M. Keys, who is president of Curtiss Aeroplane and Motor Co., and head of several others. Grouped around Keys are a number of men who control the policies of various concerns. Companies ordinarily assigned to the group include:

Curtiss Aeroplane and Motor Co. Curtiss Flying Service, which is sales agent for several companies. Curtiss-Robertson Airplane Mfg. Co. Curtiss Aero Export Co. Curtiss Assets Corp. Curtiss-Reid Airplane Co. of Montreal. Curtiss-Caproni Corp. Aviation Exploration Co. Sperry Gyroscope Co. North American Aviation, Inc., (investment trust).

Transcontinental Air Transport, in which the Pennsylvania Railroad also is interested, to combine rail-air passenger service from New York to the Pacific Coast.

The following companies do not have very close association in their manufacturing activities, but the Curtiss Flying Service holds exclusive sales contracts in this country for their products: Sikorsky Aviation Corp., Douglas Co., Cessna Airplane Co., Ireland Co., Command-Aire, Inc.

III. *Wright, or Hoyt, group.* This group is bound together mainly because Richard F. Hoyt is chairman of the board of each, and associated individuals control the policies, but the inter-relations are looser than for some other groups. Hoyt is a partner of Hayden, Stone & Co., through which the financing of the companies is arranged. The number of companies is smaller, and their size is larger than units of other groups. There is a parallel or common interest between this and the Curtiss-Keys group. Companies in the Wright-Hoyt group include:

Wright Aeronautical Corp. Keystone Aircraft Corp., and its Loening Division. Aviation Credit Corp., which finances time payments on airplanes and equipment. Travel Air Co. Moth Aircraft Corp. New York Air Terminals.

Aviation Corp. of the Americas, owning Pan-American Airways, which operates lines from the United States to Latin America. This latter company also has connections with all other groups and with independent interests.

Hoyt and Keys groups are jointly interested in the National Aviation Corp., an investment trust, which has close relations with Aviation Securities Corp., Aviation Corp. of California, Aviation Securities of New England, and Aeronautical Industries. The two groups also are interested in Aviation Credit Corp., National Air Transport, Inc., (New York-Chicago-Dallas), Transcontinental Air Transport, New York Air Terminals, Stromberg Carburetor Co., and others.

IV. *Aviation Corporation, or Harriman, group.* This is a large holding company, having also investment trust functions, recently organized with $35,000,000 cash, for acquisition of well established aviation companies. It was backed by a group of financial and investment houses headed by W. A. Harriman and Co., and Lehman Bros. It also lays claim to being the future "General Motors" of the industry. Among its principal acquisitions to date are:

Fairchild Aviation Corp., which controls various subsidiaries of that name. Universal Aviation Corp., which controls Universal Air Lines, Inc., Robertson Aircraft Corp., Northern Air Lines, etc. Southern Air Transport, Inc. Roosevelt and Curtiss Field, Long Island.

Independents. More than 60 so-called independents are not included in the four groupings above. It is a question whether a fifth large group will be formed from the independents, or whether most of them will gravitate to the existing "big four."

Fokker Aircraft Corp. of America, which is closely associated with Western Air Express, constitutes one of the most important groups of the so-called independents. A few of the other independents are:

Great Lakes Aircraft Co., Glenn L. Martin Co., Buhl Aircraft Co., Warner Aircraft Engine Co., Pitcairn Aircraft, Inc., Stearman Aircraft Co., Stinson Aircraft Corp., Mahoney-Ryan Co., Lockheed Aircraft Co., Lincoln Aircraft Co., Consolidated Instrument Co., Claude Neon Lights, Bellanca Aircraft Co., American Eagle Aircraft Corp., Alexander Industries, Inc., Air Investors, Aero Supply Manufacturing Co., National Aircraft Materials, Swallow Airplane Co., United States Air Transport, Consolidated Aircraft, and Allied Aviation Corp.

Avocados—Alligator Pears

These Tropical "Fruits" May Become as Important as Oranges in Our Daily Diet When We Learn to Like Them

By GUY ELLIOTT MITCHELL

FLORIDA, the land of fruits and flowers, is fast attaining quantity production of the alligator pear, or avocado as it more properly should be called. Southern California is not behind in this respect. Thousands of acres in both states are bearing full crops of this singular fruit, which is in substance a vegetable, and is perhaps the most nutritious of any tree product.

Many have eaten avocados but do not like them at first. They are somewhat insipid and seem to lack flavor, even though they are nutritious. This probably has been the reaction of the large majority of those who have been introduced to the new delicacy. How is it, then, that practically every traveler returning from the tropics likes the avocado, and that everyone in the tropics eats it with relish? The answer probably lies in acquisition of taste. Did you like your first raw oyster, or your first olive? But oysters and olives are in demand.

The ordinary avocado somewhat resembles a large pear, although some varieties are perfectly round. Its size ranges from as big as a hen's egg to that of a large grape fruit. The tree is tropical or semi-tropical and will not stand a heavy frost, so the growth of the avocado will be limited to the lower fringe of the United States. We are indebted principally to Mexico, Central America and the West Indies for the avocado.

"Three or four tortillas, a good sized avocado and a cup of coffee; it is a good meal," many well-to-do Mexicans or Guatemalans will say. The tortilla, as we know, is nothing more than a very thin cake made of cornmeal, and anywhere in Guatemala and in parts of Mexico you may see an Indian *cargador* making a meal from an avocado and these tortillas. Apparently this is a diet that the Indian finds sustaining under the most severe physical exercise, for the *cargador* frequently carries 150 pounds on his back and makes little of tramping 100 miles with this load in five or six days. The fats, the proteins, and the carbohydrates—all the food elements are found in the avocado that are in a mixed diet of beefsteak, bread, and butter.

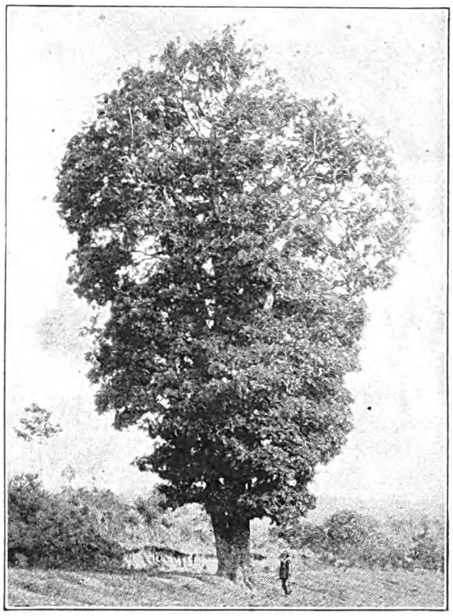
GUATEMALAN AVOCADOS
These are of the largest variety yet found here, weighing two and a half pounds each

BUT while the Indian usually eats his avocado straight, with perhaps only a little salt, this strength building food is just as available in the form of a delicate salad or any of the toothsome dishes in which the avocado is the *piece de resistance*. By many it is most relished with only the addition of salt, pepper, and a dash of vinegar or lemon juice, yet it blends admirably with other salad ingredients and with more staple foods. In Central America it is the custom to add cubes of the fruit to meat soups at the time of serving, and in the West Indies a delicious omelette is made by adding finely cut avocado in the same manner as we use cheese or tomato.

If this is all true, why has not the avocado come into general use in the United States as a food, since it has been known here for a dozen or more years? The answer is, first, that growers are always cautious about planting expensive orchards with a new fruit the reception of which by the public is somewhat uncertain, and second, that we already are blessed with a great many good things to eat in this country, and any new product is always slow to make its way and create a demand for itself.

The avocado is somewhat of a luxury at present but growers in California and Florida have gone through the dangerous stage of determining the best of the hundred or more varieties and are even now engaged in what may be termed quantity production, while on the other hand the public demand has so increased as to assure them a ready market for all they can produce, so that hundreds, even thousands of new orchards are being planted every year. Soon the price will be commensurate with a modest purse.

The tree is a free bearer, and begins to fruit four or five years after planting. Allowing for all sorts of contingencies, avocados can be sold by the grower, it is stated, at five cents each or less, and still be highly profitable. The president of the California Avocado Association states that he expects to see the avocado sold on the market for five cents. The different varieties come into bearing at different seasons so that even today it is possible to find ripe fruit in both California and Florida on almost any day in the year. The avocado is a good shipper and eventually it will be common on our fruit stands. And here is a point to note: The avocado should be eaten dead ripe as then it is at its best and one can more readily learn to like it.


AVOCADO TREE
This huge specimen is growing near Momostenango, Guatemala. Note man standing at right of the trunk of the tree

A fair sized avocado weighing about a pound, according to the Department of Agriculture, has the equivalent in food units (calories) of six eggs, or a pound loaf of bread, or a good-sized broiled steak. As a fruit it stands in a class by itself, with a far higher caloric value than any other fresh fruit except the olive. Probably, however, it will always be considered a "fruit," for the flesh is soft, about the consistency of a dead ripe banana, and very smooth, melting, and custardy.

REPAIRING RAVAGES OF TIME

A general repair of the city wall has been going on for some time. Missing stones have been supplied; broken stones have been repaired and pointed up, and a pathway provided

Walking Around Jerusalem

The Ancient Walls of the City of David and Solomon Are Being Restored

By HAROLD J. SHEPSTONE, F.R.G.S.

"BUILD thou the walls of Jerusalem," said the Psalmist, and these famous walls are actually in the hands of the builders. Shortly after the declaration of peace an influential body, known as the Pro-Jerusalem Society, was founded, whose aim is "to preserve the ancient monuments, encourage technical education, plant trees, and in general beautify the ancient and historic city of Jerusalem." It is an officially recognized body, and receives a grant of 10,000 dollars a year from the Palestine government. The whole of this sum, and also any other money that may be contributed by interested persons, is spent upon the actual work of preservation.

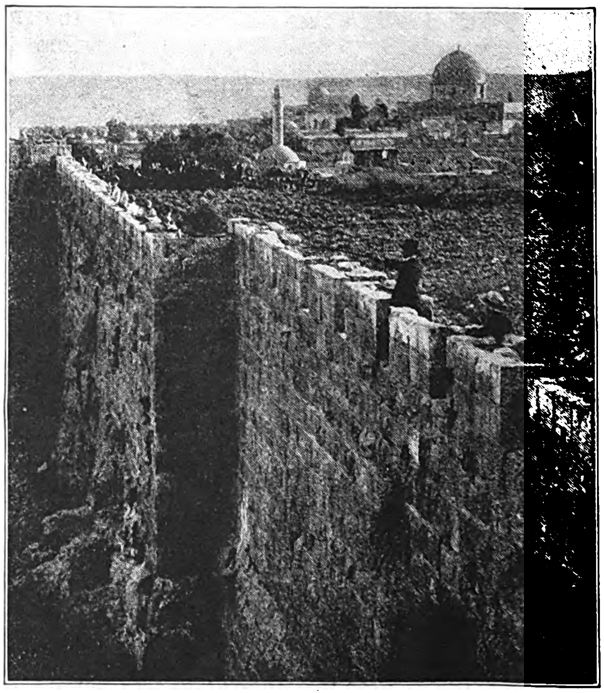
During the last few months it has devoted a great deal of attention to the walls of Jerusalem and it is now possible to walk around on them. What a world of romance these ancient walls record! They carry the mind back to the early days of Hebrew history, for it was David and Solomon who first enclosed Jerusalem by a wall. Nehemiah subsequently enlarged and extended them, and there they stood in all their glory at the time of Christ.

When Titus, the Roman general, destroyed Jerusalem in the year 70, he pulled down its old walls and laid the city in ruin. Then an entirely Roman city arose on the sacred sites only to be destroyed once more by the Persians. The present walls were built by Suleiman the Magnificent in 1536-42. This is attested by the numerous inscriptions found on the gates. According to local tradition it was the work of two brothers, who commenced at the Jaffa Gate in opposite directions, and never saw each other again for seven years, finally meeting at the St. Stephen's Gate, in the eastern wall, where they placed their marks—the lions. This hardly seems credible, but the East is as full of romantic stories as the "Arabian Nights."

THE circuit of the walls, which vary in height from 38 to 40 feet, is about three miles in length, enclosing about 200 acres—one sixth of its extent being devoted to the temple area, which contains 35 acres. The walls are graced with 34 towers and eight gates—one of which is permanently closed. The only gates of importance are the Jaffa Gate, the Damascus Gate, and St. Stephen's Gate.

The question the layman naturally asks, is, do the present walls mark the boundary of the city of Christ's day? We know that the remains of the former walls were left as they had been thrown down, and that the same stones were built more or less on the same foundations. Here and there slight deviations were made but, generally speaking, the present wall stands in the line of its immediate predecessors. No regard was paid to the respective marks of former builders as is shown in the dressing of the stones. Hence we see the Byzantine above the Crusaders, and the stones of Christian masons resting on those of pagan Rome. It is only where foundation courses exist that we can see the different building epochs represented by their respective positions in the structure. And these are infallible proofs of their antiquity, just as much as the intermixture of stones shows the work of the latest builder.

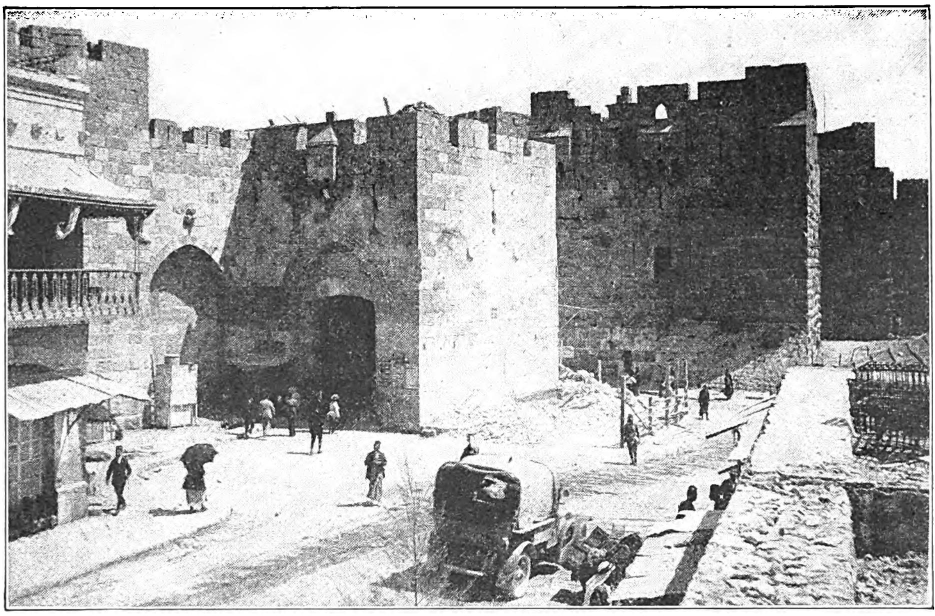
WE know from excavations made by the Palestine Exploration Fund the course of the first wall built by David and Solomon, but one cannot be certain as to the course of the second wall which marked the boundary of the city in Christ's day. For instance, the Church of the Holy Sepulchre, which is said to mark the site of Christ's burial, lies within the present walls. Now Christ was buried "without the city walls," and many scholars place this portion of the north wall to the south of the church. The failure to determine the exact course of the second wall along this point leaves the problem of the site of



A POINT OF VANTAGE

Visitors looking from the north wall of Jerusalem. The dome of the mosque of Omar is at the right the Holy Sepulchre an unsettled one. Evidently the Jerusalem of Biblical days was a small city, about 200 acres in area. Yet it contained Solomon's magnificent temple, the King's palace, other large buildings, and the dwellings of its inhabitants.

Until just about a century ago there were no buildings beyond the city walls, and at sun-down (as also at noon, during the Mohammedan prayers, on Friday) the gates were all closed, and it was almost all a man's life was worth to arrive after the gates were closed. We know how Christ likens the entrance into the Kingdom to a man passing through the straight but narrow gates of a city. He had often seen the people at sunset hurrying to the gates and passing through their narrow entrances with their twists and turns, into the city.



TRULY ORIENTAL

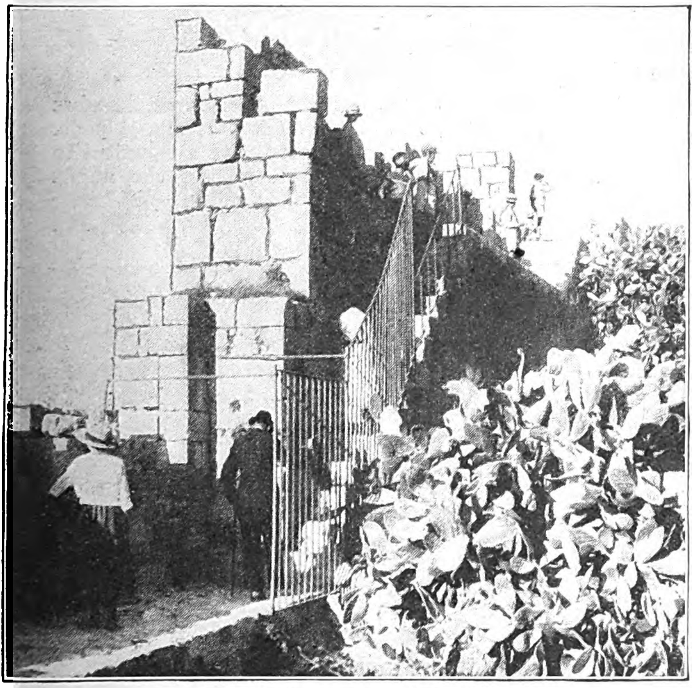
This is the Jaffa gate as restored. Existing gateways had to be widened for modern traffic

WHEN the Jews began to return to the city of their forefathers, and Jerusalem could not hold them, people ventured to build outside, first with a good deal of apprehension and considerable danger, but later, in larger numbers and with considerable fearlessness. Here it is interesting to note that the line of improvement has followed closely the descriptions of the re-building of Jerusalem given in Jeremiah XXXI, 38 to end, and in Zachariah XIV. Then one of the gates was left open all night, and presently a second, and so on until all were never closed. In fact they now have no doors to close.

Then came the building of carriage roads to Jaffa, Bethlehem, Hebron, Jericho, Nablus, and Ain Karim (the reputed birthplace of St. John), when it was soon discovered that the existing gateways were far too narrow for the increasing traffic. Two of them were accordingly taken down, and a portion of the wall cut away, giving sufficient space for a carriage to pass straight in instead of having to turn.

During the Turkish régime nothing was done in the way of preserving the walls. As a result they fell into a very dilapidated condition, more particularly with regard to the top stones, many of which were carried away. Besides, each land owner within the walls blocked the walls at both extremes of his property.

Through the efforts of the Pro-Jerusalem Society the missing stones have been restored, the rubbish and growth which covered certain portions of the walls have been removed, the obstructions that prevented a continuous path have been taken down, and here and there, in dangerous parts, iron rails and bannisters have been provided. To-day, anyone, on paying the fee of half a dollar, can walk from the Citadel to the Mosque enclosure, either way. Climbing the wall by the Citadel, near the Jaffa Gate, you can take the eastern walk to the mosque or temple enclosure, while if you walk the other way to the west you pass about by the Jaffa Gate, Damascus Gate, Herod's and St. Stephen's Gates to the other extremity of the mosque enclosure. Thus are the walls of the Holy City being preserved and protected for posterity.



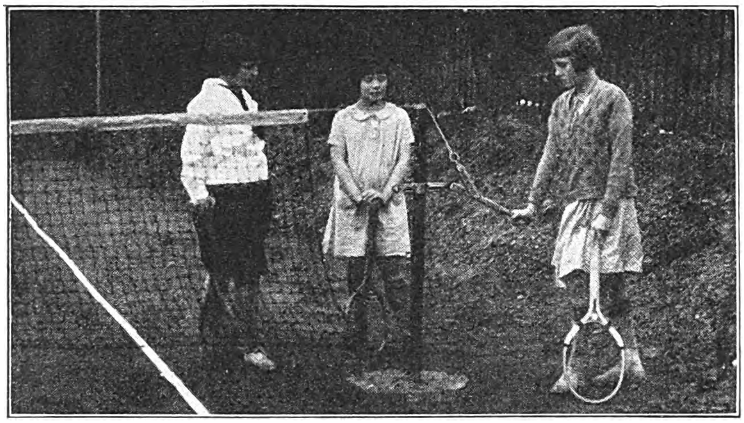
WALK IN SAFETY

Steps and iron railings make a circuit of the walls a safe journey. Tourists are overlooking Jerusalem from this advantageous position

WALLS OF JERUSALEM

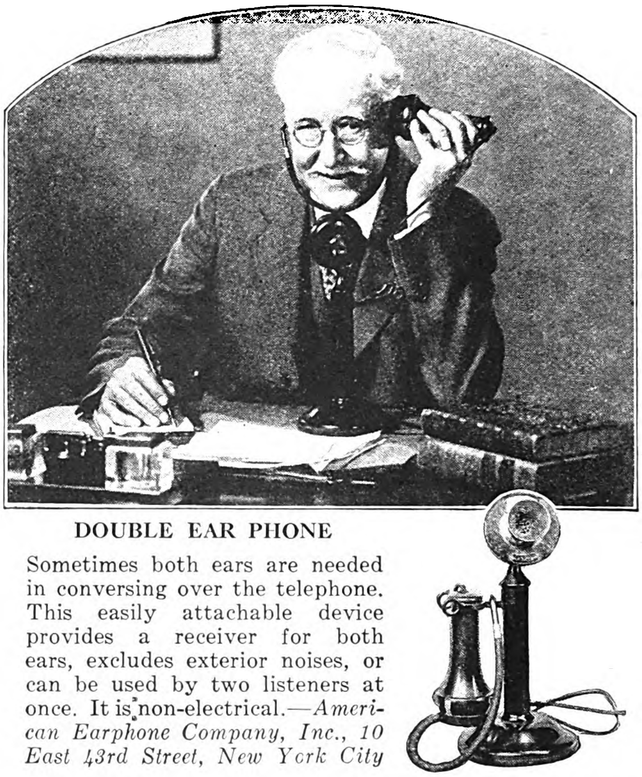
These walls are forty feet high and an entire circuit of the ancient Holy City can now be made along the pathway on top of them

Inventions New and Interesting



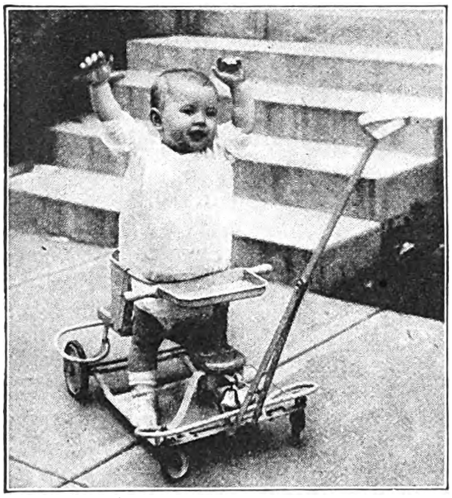
SIMPLE TIGHTENER FOR TENNIS NETS

Eliminating the slack and raising the tennis net to the proper height is facilitated by this device, which operates so easily that children can tighten a net easily and properly. The pole has no gear ratchets.—*M. R. Lane & Sons, Ardmore, Pennsylvania*



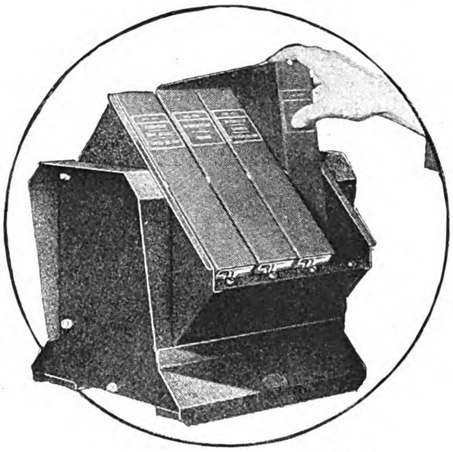
DOUBLE EAR PHONE

Sometimes both ears are needed in conversing over the telephone. This easily attachable device provides a receiver for both ears, excludes exterior noises, or can be used by two listeners at once. It is non-electrical.—*American Earphone Company, Inc., 10 East 43rd Street, New York City*



BABY ROADSTER

Everything but a rumble seat is provided on this adjustable perambulator for fresh air babies. It can be pushed or pulled by an attendant, or operated by the baby.—*The W. J. Baker Co., Newport, Kentucky.*



TELEPHONE BOOK RACK

These steel-backed cloth-bound binders made to hold four telephone directories fit into a special rack which is equipped with a pivot. Each binder swings in a semi-circle, resting on the rack when it is opened.—*Pressed & Welded Steel Products Company, 11th St. at 40th Avenue, Long Island City, New York.*

STEEL-WOOL POLISHER

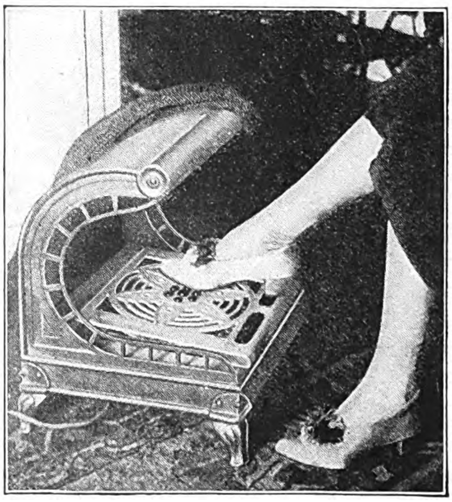
Cloth covered steel wool brushes make convenient polishing pads. They are treated with a chemical to resist rust, and protect the hands while scouring utensils.—*Whiskette Manufacturing Co., Terre Hill, Pa.*

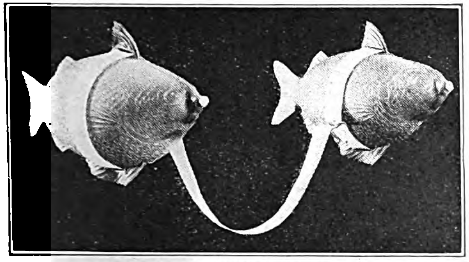
< FLEXIBLE RUBBER STAMP

The handle of this rubber stamp is attached to a Bakelite base by a small section of rubber which provides sufficient play to assure a clean impression despite the angle at which the pressure is applied.—*Lake Manufacturing Co., Dallas, Texas*

CURE FOR COLD FEET >

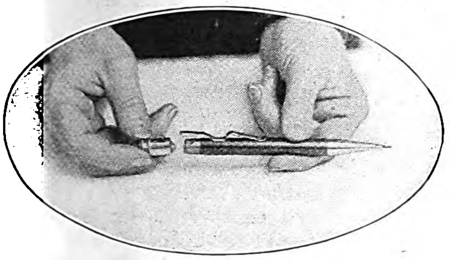
Just enough heat to warm the feet, without causing them to become too hot, is provided by this electric warmer. The only perishable part is a small resistance coil which will last for several years.—*Simmons Research Corporation, Ostend and Denver Streets, Baltimore, Maryland*





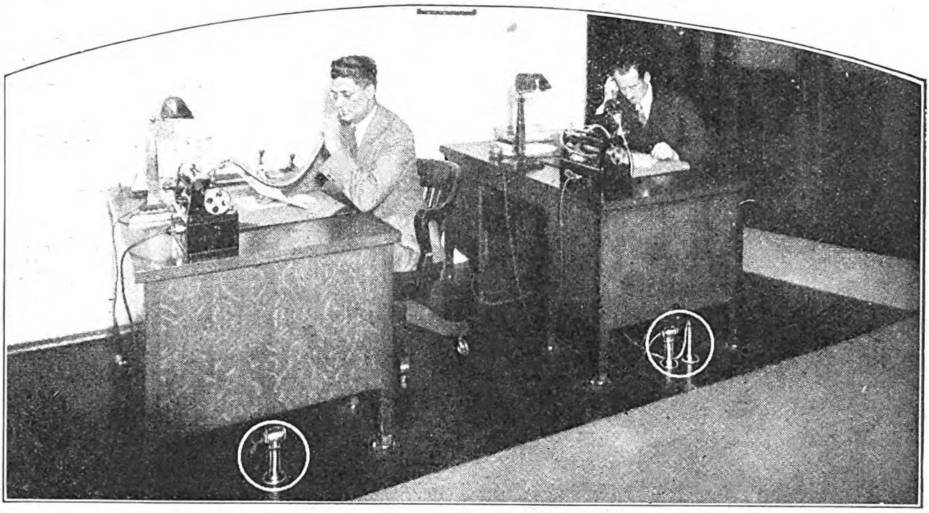
NOVEL WATER WINGS

These queer-looking "fish" have been harnessed to assist would-be swimmers. They can be inflated like the usual water wings, and will support a grown person.—*Kleinert Rubber Co., 485 Fifth Avenue, New York*



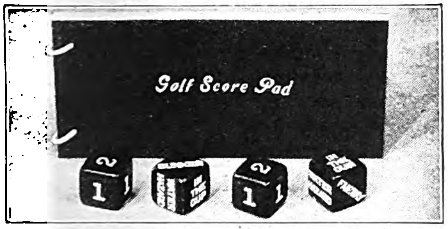
PENCIL-LIGHTER

Now the combiners have wedded the mechanical pencil to the cigarette lighter. The pencil-lighter has the customary muzzle-loading features for the lead.—*Lyco Company, 2633 W. Canton Street, Chicago, Illinois*



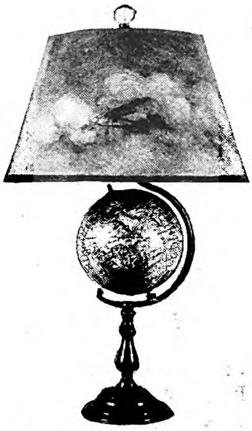
FLOOR CONNECTIONS FOR ELECTRICAL DEVICES

For desk lamps, adding machines, telephones, annunciators, and other electrical fittings indispensable to the modern office, these little floor plugs have been designed. The outlet in the foreground is fitted with a two-way connection for either high or low tension applications. The fittings and floor connections are made of brass.—*Russell & Stoll Company, 53 Rose Street, New York City, N. Y.*



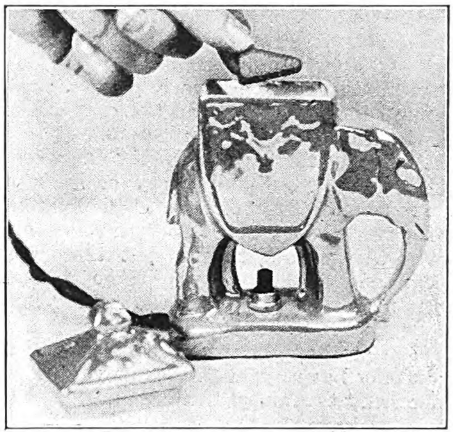
INDOOR GOLF GAME

Lady Luck now plays golf, with inlaid dice and a score card for keeping track of the strokes of the players. "Golf" put-and-take tops with the same characteristic markings are made by the same firm. —*Elkloid Company, Providence, R. I.*



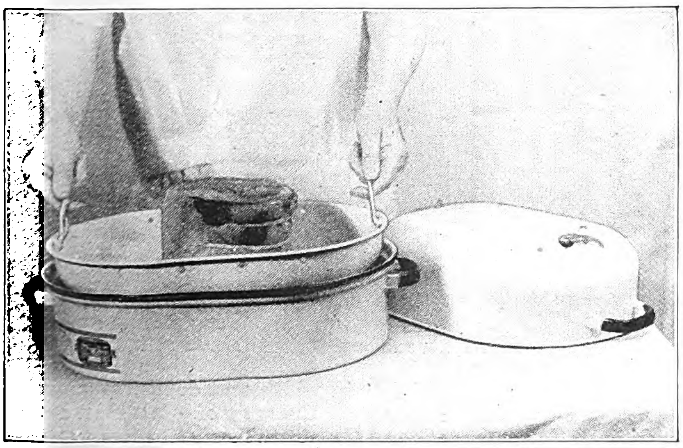
LIGHTING THE WORLD

Lindbergh probably inspired this combination globe and lamp. The parchment shade is decorated with clouds, stars, and an airplane in flight. The globe revolves freely, and is eight inches in diameter.—*Heather's, 411 Fifth Avenue, New York City, N. Y.*



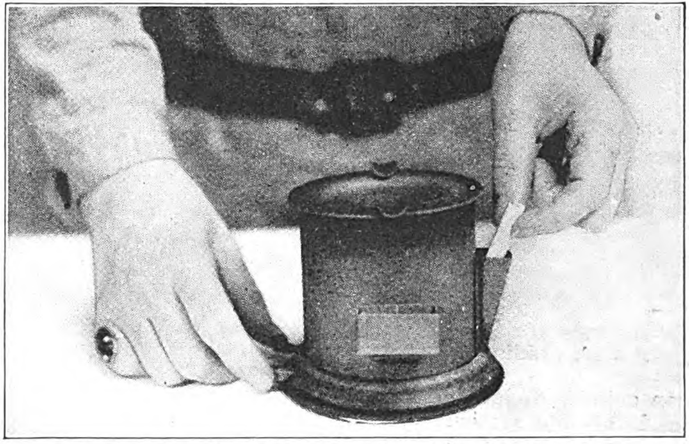
ELECTRIC INCENSE BURNER

To use this unusual incense burner, one merely drops a piece of incense in the top, replaces the lid, turns on the current, then turns off the electricity when the incense is ignited.—*Electra Cense Burner Company, 2314 Keyes Avenue, Madison, Wisconsin*



THREE PIECE ROASTER PREVENTS BURNING

The bottom pan is filled with water, just below the perforated tray in which the roast is placed; sufficient steam is generated to keep the roast juicy without basting. The meat cannot burn.—*Geuder, Paeschke & Frey Company, St. Paul Avenue and 15th Street, Milwaukee, Wisconsin*



CIGARETTE CONTAINER AND ASH TRAY

By pushing the lever at the base, a cigarette is ejected into the hopper at the right. Another push replaces it, if it does not happen to be the desired kind. The tray rests in the top of the container, and is removable.—*The Keller Company, Inc., Brokerage Building, St. Paul, Minn.*

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Railroad Travel De Luxe

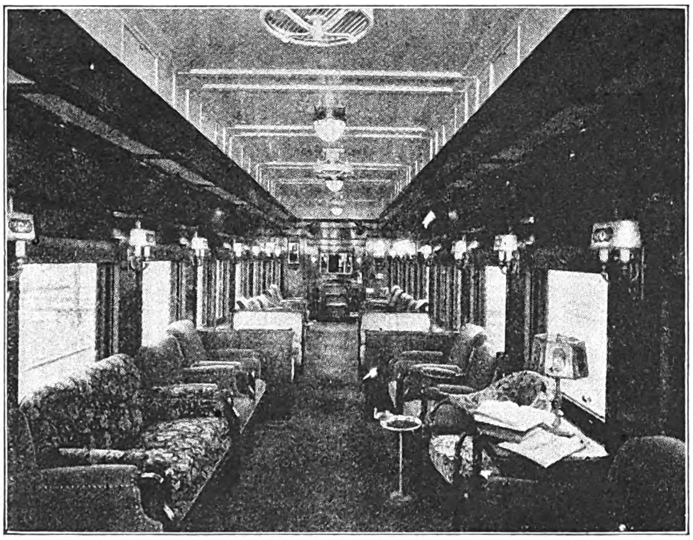
WHEN the train pulls out of the terminal and your luggage is stowed away, an anticipatory smile comes over your face as you head for the lounge car. You've been looking forward to this moment for days, perhaps, for your trip is arranged over the Burlington Route and you've heard of the splendid cars, devoted entirely to lounging purposes and free for all Pullman passengers, now carried on crack trains of that road.

Arriving in the main lounge, you make yourself at home but, what is more, you actually feel at home. The beautiful chairs and divans you find are as pleasantly comfortable as they are handsome. You find that they can be shifted around, too, if you are visiting with a friend or if the view out-of-doors is particularly attractive. When you entered the car, you noticed the unobtrusive richness of the decorations; the fine brown of the walnut paneling that reaches to the ceiling is a perfect background for the greens and the gray-greens of the chairs, carpet, and ceiling.

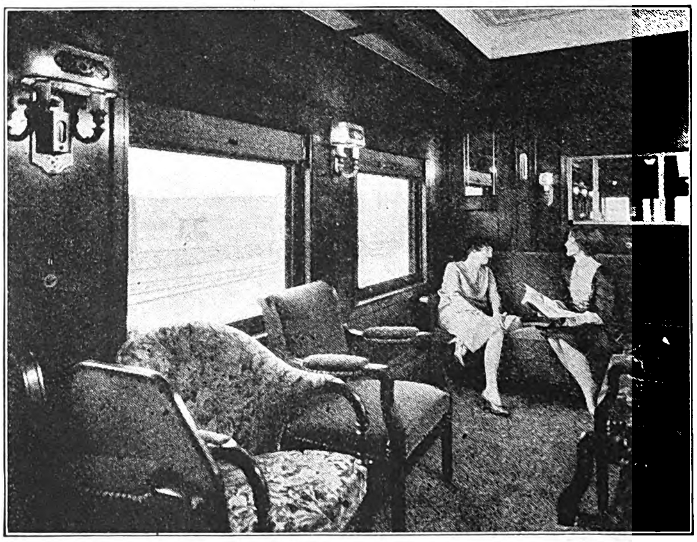
A smoke would taste good? Of course. About you, you find plenty of smoking stands—and little electric cigar lighters. *They* work! But where does all the smoke go? Others are smoking yet the air is clean and fresh. Oh yes, those exhaust fans near the ceiling and the regular fans must do the trick.

You are happily surprised to learn that you may have buffet service at your chair merely by touching a button, and that you can enjoy the view from an entirely new kind of observation platform—a sun parlor where cinders can't reach you but some of the healthful ultra-violet rays of the sun can come through the Vita-glass that surrounds it.

People about you are playing cards, others are writing at tables supplied for the purpose, others are reading; and you settle back comfortably in a deep-cushioned, leather-upholstered chair as though you were in your own club at home. You resolve to tell others of this traveling "living room" which, you learn, is the result of many months of painstaking work on the part of Burlington and Pullman engineers.



Interior of one of the lounge cars on the Burlington Route, product of Burlington and Pullman engineers



A corner of the ladies' lounge in the car shown at the left. Its main features are spaciousness and comfort

Just What Is a Robot?

ONE of our correspondents in the Department of the Interior, Ottawa, Canada, proposed a curious question which concerned the derivation of the word "robot." We consulted all the dictionaries in our library and prosecuted inquiries wherever we thought they might prove fruitful. We finally wrote to Mr. R. J. Wensley, who is the creator of the Westinghouse electric robot. Mr. Wensley wrote us as follows:

> . . . "I am informed by a student in our Apprentice Course, who comes from Czecho-Slovakia, that the word is a Czechish word which, literally translated, means a very hard working man doing heavy manual labor. The word came into use because of its appearance in the Theater Guild Play 'R.U.R.' by a Czechish writer, Capek."

The above information was relayed to our correspondent, who in turn gave us some additional information of which the following is an excerpt:

> . . . "With reference to your reply, it quite disposes of my previous idea that the word is of modern and synthetic origin. I would have answered you sooner, but for the fact that, based on the start you give me, I have been checking the matter through a little further with the help of two or three men in Government service here who are of Slavic birth and education. They all confirm the information that you obtained, the word or closely allied derivatives being found in both Polish and Czech as meaning work, worker, or manual laborer. In fact it is also found in other than Slavic languages, because a very old dictionary which we unearthed gives Robat, Robath, Roboth, Robold, Robald, and Robelt as proper names, each and all meaning worker."

Power Machine Gives Artificial Respiration

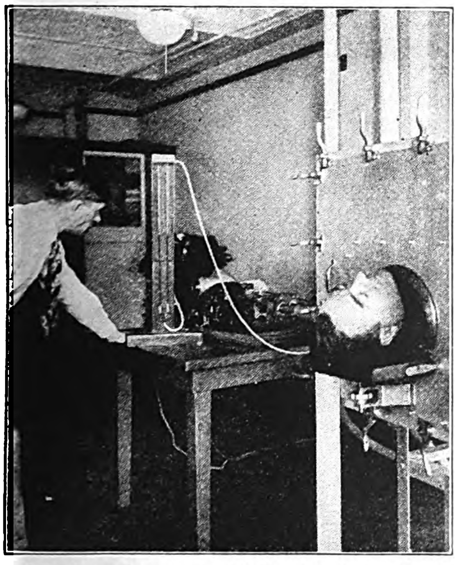
VICTIMS of accidents interfering with breathing and circulation can now be resuscitated by a respirator machine operated continuously by electricity, just installed in Bellevue Hospital, New York, through the courtesy of the Department of Hospitals. It is introduced as the first satisfactory appliance for administering artificial respiration over long periods. It could have been employed, for instance, to take the place of the 20 policemen, who recently worked in relays for five days to restore an unconscious woman. Its range covers asphyxia due to electric shock, concussion, gas poisoning, smoke, and drowning.

This mechanical respirator was perfected after nearly two years of experiments by its designers, Philip Drinker and Louis A. Shaw, of the School of Public Health, Harvard University, and constructed at the request of the Committee on Resuscitation of the gas and electric companies affiliated with the Consolidated Gas Company of New York City.

The appliance is a heavy metal tank equipped with various accessories. The tank itself is 6 feet in length and about 2½ feet in width and depth, and can accommodate the body of a tall man of large girth. Its plates are electrically welded so that every joint is air tight. When the machine is required for a patient the front end is removed simply by undoing a set of hasps. From the interior, drawer-like, is slid a bed, with steel spring mattress, upon which the body of the sufferer is placed, after which the couch is pushed back into the steel shell. The head of the patient is thrust through a highly elastic rubber collar, securely clamped to a circular opening in the front panel. This collar yields to motions of the throat and yet fits snugly enough to prevent the entrance of outside air. The head, sticking out from the end, is placed upon a support bolted like a shelf to the front and resembling the rest of a dentist's or barber's chair. The end panel is then clamped or battened down by the hasps, the union being made air tight by gaskets or washers of leather. The body is thus in a container much like a compressed air chamber, or a diving bell.

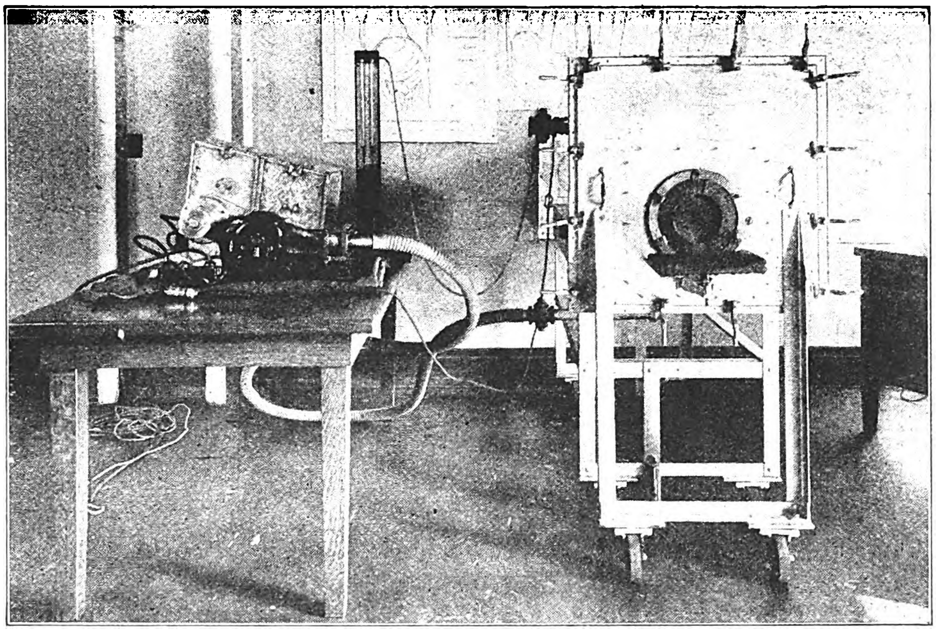
After everything is hermetically sealed, air under slight pressure is alternately pumped in and drawn out of the box in imitation of the act of breathing. The incoming current bears down on the chest and abdomen of the patient and causes him to exhale. When suction is applied the patient's lungs inflate as the outside atmosphere rushes in through his exposed nose and mouth.

Months of experimenting were spent in producing a regular and rhythmic respiration time to the age and strength of the patient. This is accomplished by a device called an alternator, an electrically controlled valve, one side of which is solid, and the other so meshed as to admit outside atmosphere. The air is circulated by blowers, of the type used for vacuum cleaners, which act as pumps. After passing through the blowers it comes in contact with the alternator valve which sends air currents through two branches of a "Y" tube. In general, 15 breaths a minute are prescribed for adults and children over five years of age, and from 22 to 25 respirations for babies. The patient thus can be made to breathe deeply or shallowly and as quickly or as slowly as the attending physician deems best. The machine is often tested by watching the pulsations of a soft rubber diaphragm substituted for the collar.



While a doctor watches the pressure of air that is being supplied, a victim of asphyxiation is being treated with the new equipment

Besides watching the face of the patient for variations in color of the skin and lips, to guide him in his treatment, the doctor or nurse on duty can also observe the body for symptoms by looking through a glass covered porthole in the top of the machine. As the glass is of quartz composition, X-ray photographs can be taken through it.



The power machine that gives artificial respiration. Note the hole through which patient's head protrudes during treatment; also the motor and air hose

A thermometer run through an air tight joint in the top of the machine records the temperature within the box. If the doctor notes that the mercury column is too far down, he switches on an electric light inside; if the heat is too high, he opens the port and lets in outside air until the temperature drops.

There is also a water gage which guides the operator in regulating the device. If air pressure gets too heavy, the gage or manometer overflows—safety-valve wise—and the pressure is automatically lightened. Through a rubber lock-like device in the side of the tank, the tube of a blood pressure testing instrument is led. A supplemental steel container can also be placed over the patient's head into which oxygen or mixed gases can be forced for inhalation, if required.

If able to receive nourishment, the patient can be fed, and he can also talk while artificial respiration is in progress, or fall into restful sleep. The inventors say this is probably not true of any other methods.

Electric Heat in Fig Packing

ALTHOUGH classed as sub-tropical fruit, figs grow naturally in a wide latitude ranging from the tropics to warmer climes of the temperate zones, more than one hundred varieties being listed. The dried figs of commerce, coming principally from the Mediterranean countries and California, were the only form in which this delicious fruit was shipped until a relatively short time ago when preserved figs were introduced.

Early in the history of California fruit-canning, efforts were made to preserve and can figs but with little success. Not until the Kadota fig, really the Dattato fig of Italy, came into bearing in a small way about 10 years ago, did the canners and preservers meet with much success in canning and preserving this fruit.

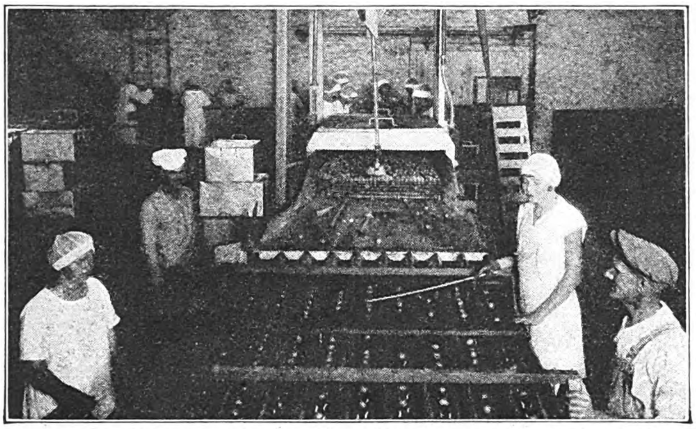
The Kadota fig seems to be particularly adapted to canning. Its seeds are very small and scarcely noticeable in the eating, while the skin is just sufficiently firm to hold the fig together during the process of canning. The color appeals to the eye and the flavor is always uniform and sweet.

The Kadota fig thrives best in the San Joaquin Valley where there are now approximately 3000 acres in bearing. New acreages are coming into bearing each year. The trees are planted about 75 to the acre and are rigorously pruned back each year, the choicest fruit appearing on the new wood each summer. Harvesting begins about August 1 and ends about October 15. In order to get the fruit at its best the orchards are generally picked two or three times a week, and daily during the period of heaviest production.

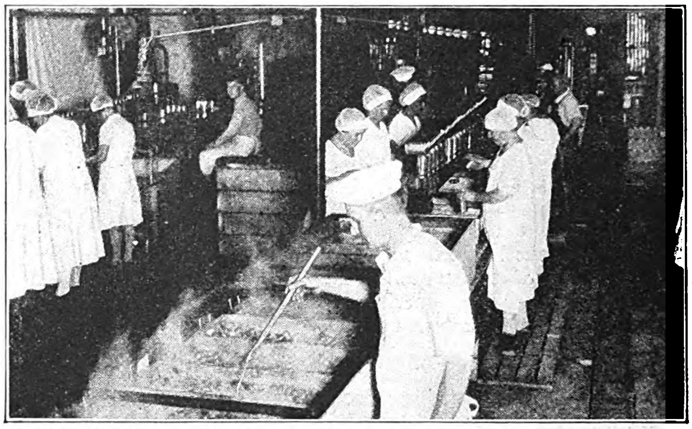
The old-fashioned preserving method of boiling the fruit and sugar in open copper or aluminum kettles until cooked, then cooling the fruit to be placed in the package, later followed by reheating, sealing, and final heating for sterilization, resulted in a product too expensive for general use. There was no possibility of making this a staple every-day food at popular prices. The need of a more economical and efficient method of packing was seen several years ago by the Beckwith Company of Reedley, California, where there has been developed a method of continuous semi-automatic cooking using electricity as a heating agent. Figs arriving at the Beckwith plant are processed and sealed in containers within a few hours without any preservative other than pure cane sugar.

On arriving at the plant the first step is the sorting which is done by placing the fruit in a single layer on a wide moving belt. All fruit is clearly visible to the inspectors who remove the over-ripe, green, or imperfect fruit not up to requirements in quality. The perfect fruit then passes along on the belt under intense sprays of water where it is thoroughly washed. Rolling from the belt, the figs pass through a grader which separates the fruit into six sizes. Dropping from the grader the various sized figs roll into spotless re-tinned screen bottom containers which drain all water from them.

Poured into cooking pans in evenly measured batches of 30 pounds, the figs are placed on an electric heating table where they are moved forward at short intervals. Within a few feet of travel above the intense heat the figs are soon boiling. Sugar is then added and the heat tempered some-



Figs as they come from the orchards are passed through this machine for inspection, sorting, and washing



The finishing touches in the preparation of canned figs. Here enough sugar is added to bring out the flavor

what, the figs continuing their travel on to the end of the apparatus for a period of about 60 minutes, when they are finished.

Without leaving the apparatus, the pans pass between rows of operators who lift the figs with spoons into various sized, washed, and sterilized cans, leaving the syrup in which the figs have been cooked for further concentration. The filled cans travel along a conveyor to a syruping machine where the treated concentrated syrup is added. The cans are then sealed without solder in a seaming machine and pass directly into a rotary sterilizing apparatus. The temperature of the cans is brought down to normal in cold water, when they are ready to be labeled and cased for shipping. The only time these figs are touched by human hands is when they are picked from the tree.

The intense steady heat given off by the electric cooking tables makes possible this continuous method of cooking. Steam customarily used in heating the jackets of the old style stationary kettles cannot be employed in a moving apparatus nor would it give sufficient heat in limited time to make continuous operation possible. The close control possible in electric heat is another element in its favor. The perfect cooking which brings out the delicate flavor of the figs packed by this company is made possible by electric heat.

In the Beckwith plant are four electric tables each containing 38 three-quarter-inch Glowbars 20 inches long, of initial rating of 3.3 kilowatts each, making a total of 125.4 kilowatts for each table. Two 110-volt 38-32 ampere Glowbars are connected in series on a 220-volt circuit. The heating area of each table is 75 square feet providing a capacity of 1000 to 1200 pounds of fruit per hour.

The conservation of heat through adequate insulation is a feature of the installation. By means of a scientifically worked out plan, heat losses are reduced to a low minimum. The floors of the cooking chambers are covered with several layers of insulating materials and the side walls are covered with asbestos. Because the heat is free from fumes or gases, it is possible to direct practically all heat generated by the Glowbars directly into the pans where it is active in cooking.

Magnifying Glasses Helped Eyes of Ancient Egyptians

WHEN the eyesight of Egypt's wise men grew feeble from study they used magnifying glasses to enable them to read more easily the stone tablets and papyrus rolls. This is indicated by pieces of round glass from Egypt, one of which, now in the Ashmolean collection, may date back to the first dynasty of Egypt, or about 3500 B.C. That magnifying glasses were known in the famous civilization of Crete, about 1200 B.C., had been shown by two crystal lenses discovered in the Cretan ruins.—*Science Service.*

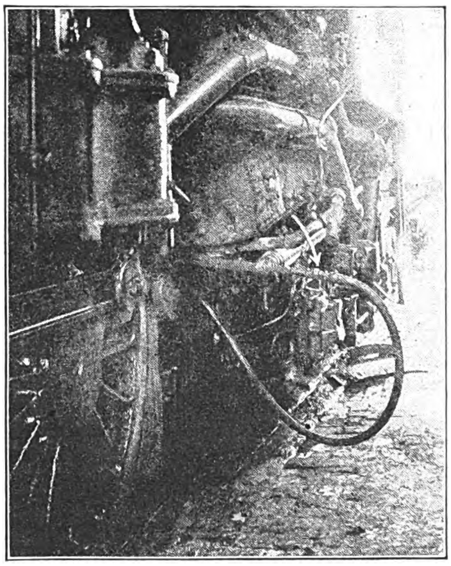
Gas-Firing a Locomotive

A SAVING of 24,000 dollars yearly is now being made by the Southern Pacific Railroad Company by the use of natural gas for firing locomotives in getting up steam in the Los Angeles shops. As far as is known, this had never been done before.

After a run, a locomotive is placed in the round house, thoroughly inspected, and prepared for its next trip. Prior to the use of gas, steam had to be taken from the boiler plant to break up the oil before the engine could be fired when being prepared for service. With the use of gas, however, all that needs to be done is to attach a gas line from the shop mains to the oil burner, apply a torch, and the fire is ready. The gas flows through the regular oil burner, and uses it as a gas burner. The gas fire provides a means of gradual heating of the engine which could not be had under the old system of firing, thus bringing up steam at any desired time. This is very much easier on the engine itself and its mechanical equipment.

Some of the other advantages of using gas for this process are the fact that the engines can be fired in much less time than formerly; the smoke nuisance is avoided; the fire hazard from oil drippings is done away with; and finally, there is the financial saving of more than 24,000 dollars a year.

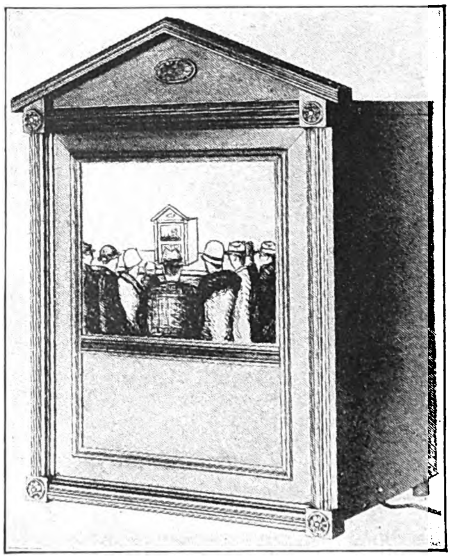
The Los Angeles round house will hold 60 engines at one time. Approximately 10,000 cubic feet of gas an hour is used to get up steam for one engine, and often from four to six engines are fired in an hour.



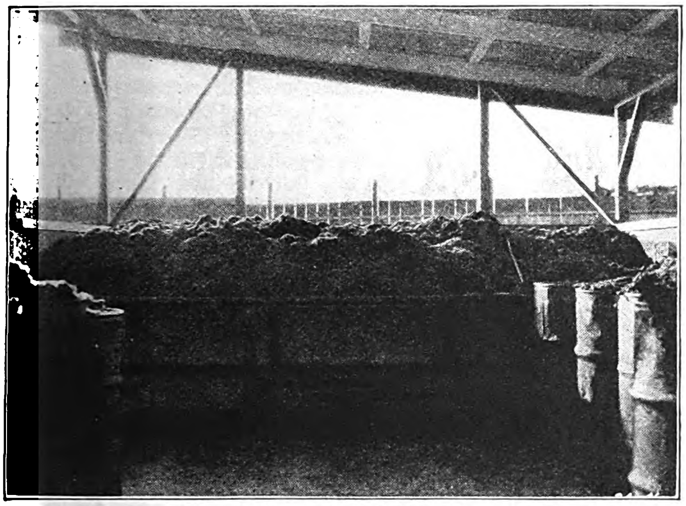
The gas connection utilized in gas-firing locomotives. The gas supply was on the far side of the engine in this case; therefore the hose was passed between wheels. Hitherto the oil was broken up by steam

Continuous Photographic Display

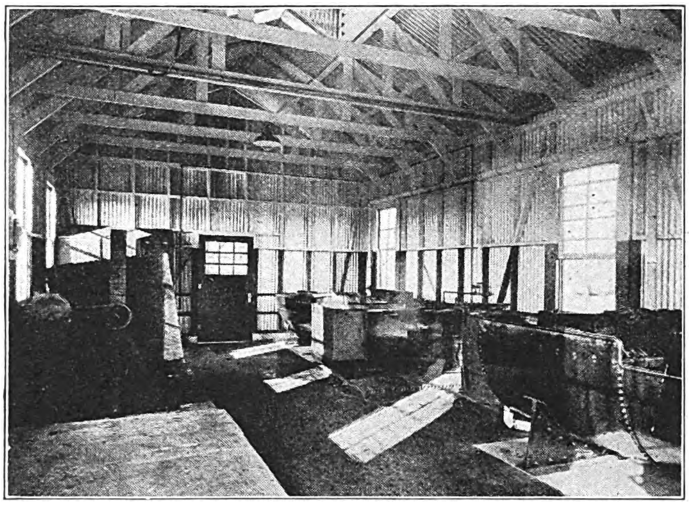
A NOVEL projector of "still" photographs for window display purposes has recently been placed on the market. The illustrations in these columns show a front view of the device and also the interior structure. A standard 35-millimeter "still" film is employed and the mechanism operates the film automatically after it is once started. Upon the completion of one showing of the strip, the operation repeats itself without any attention from an oper-



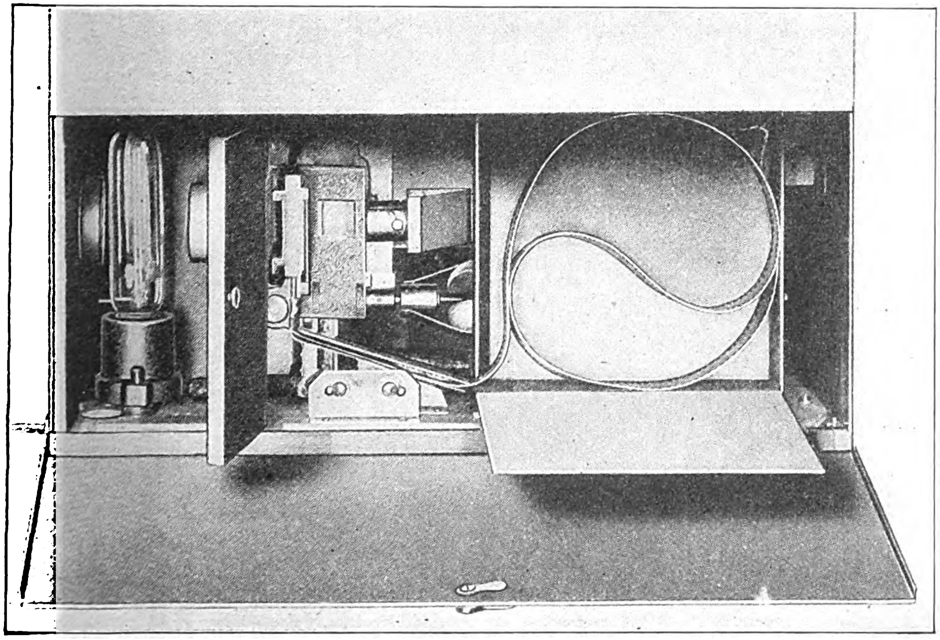
The automatic advertising photograph display machine. Crowds before store windows containing this machine evidence the satisfactory nature of such advertising ator. The pictures projected on the screen are 9¼ inches by 12 inches in size, and the projection intervals may be varied from seven to 12 seconds according to the subject matter being displayed. The pictures change silently and automatically, the entire series being repeated without interruption.



This illustration, while not intriguing perhaps, shows the sorting table, the first step in waste reclamation



To the left is the tumbler (second operation); and in proper sequence: washing vat, press, and saturating vat



The mechanism of the continuous photographic display machine. A standard 35-millimeter "still" film is shown a picture at a time, over and over

Reclamation of Waste Nets Large Saving

ENGINEERS of the Southern Pacific Company have perfected a series of devices for the reclamation of journal waste, which permits the waste to be used over and over again. Use of these devices resulted in the saving of $71,441.68 during the first 11 months of 1928. The equipment is installed in a specially-built structure which is fireproof and also equipped with a system of steam pipes for smothering flames in case any waste should become ignited.

All old waste, both cotton and wool, accumulated at the time of re-packing journals, is placed in special metal-covered containers, and shipped to the reclamation plant. There it is dumped onto a sorting table, forked over, and that portion of the waste unfit for reclamation set to one side to be burned up. Good judgment is necessary at this point, on the part of the operator, in sorting out the short-fibered and badly-matted waste for destruction. He also takes out any metal or other foreign matter that he sees at this time.

The waste left for reclamation after the operation just described is then picked over by hand, the waste pulled apart, and foreign matter discarded. This waste is then placed in a power press and the old oil pressed out. After being removed from this press, the waste is placed in a tumbler where the short-fibered waste, as well as any remaining foreign matter is removed. A stream of compressed air is blown through the waste as the material is being stirred about within the tumbler. This operation blows away practically all short-fibered waste and also removes moisture. The waste is next worked over a carding rack by hand.

The waste is then placed in a washing vat filled with wiping oil where it remains for at least 30 minutes, being worked over with a fork during this period. The waste is then removed to draining traps and from there again placed in the power press and any remaining oil removed. The waste is then pulled apart by hand to give it resiliency and placed in a saturating vat where it remains for at least two hours. The reclaimed waste is finally removed to the drainage tank and left to drain for six hours or more. It is now ready to be used again in re-packing journals.

Oat Hulls Are Burned in Powdered Coal Furnaces

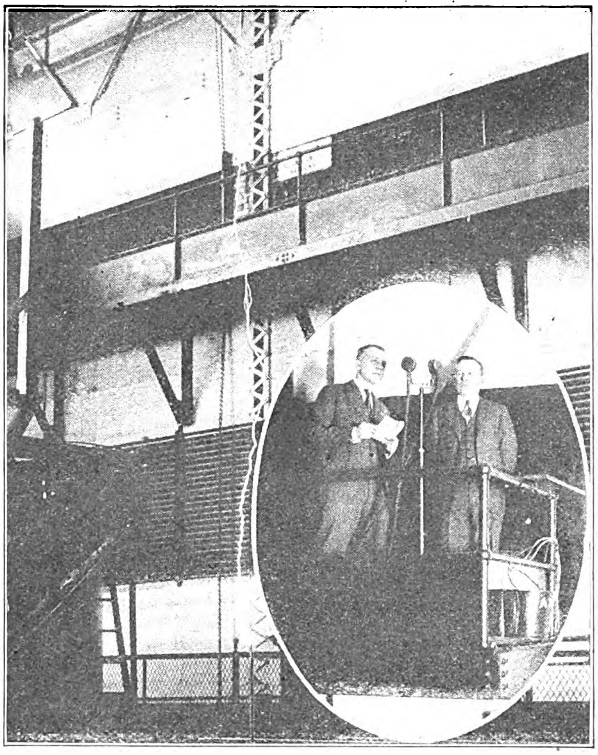
ENGINEERS, most people have decided, can solve any problem that modern civilization may present. In a recent issue of *Power*, Mr. C. J. Herbeck, Chief Engineer at the Cedar Rapids Plant of the Iowa Railway and Light Corporation, tells how a chance discovery helped the engineers to figure out that the oat hulls and other refuse left as by-products from the preparation of oatmeal can be effectively utilized by burning in powdered coal furnaces.

At Cedar Rapids, Iowa, the Quaker Oat Company has a large plant where large amounts of oat hulls are available as a waste from the manufacture of oatmeal. It was decided to dispose of the oat hulls by burning them in the power station of the Iowa Railway and Electric Light Corporation, which is only about 400 yards from the oatmeal plant.

An eight-inch underground pipe, equipped with a pneumatic blower, transported the hulls to the coal bins at the power station. In order to discover the most efficient means of combustion, a wide variety of methods was tried. Chain grates proved to be too slow. Underfeed stokers with the original drive, would not accommodate the required volume of hulls, so the original drive was disconnected and the plungers were connected directly with the crankshaft. But the result was no more favorable than with the chain grate, and particles of unburned hulls passed out of the stack and aroused criticism from the city.

About that time, it was noticed that during the time the soot blowers were in operation, practically all the smoke from the burning hulls was eliminated. This led to experiments with forced draft over the fire, and it was found that burning the hulls in suspension is much the better way.

Using two boilers equipped for powdered coal, a flexible arrangement was devised



Crashes of artificial thunder, produced by the new 5,000,000-volt lightning generator of the high voltage laboratory of the General Electric Company, at Pittsfield, Massachusetts, were to be heard recently during a talk on lightning delivered by F. W. Peek, Jr., consulting engineer of the above named company, from station WGY. The accompanying photograph shows one of the high-voltage sparks jumping a wide needle gap in the laboratory, while in the inset are Kolin Hager, broadcast announcer of WGY, at left, and F. W. Peek, Jr. The General Electric Company is actively engaged in studying lightning to determine its characteristics—as much as possible—with the purpose of learning how to protect transmission lines more efficiently

whereby either hulls or powdered coal can be used, without taking the boilers out of service for the change-over.

During certain seasons other uses are found for the oat hulls, but there is a quantity of other refuse that must be disposed of. By erecting a partition in the coal bunkers, this refuse can be stored conveniently, and later fed through the individual feeders to be burned with the powdered coal. By adjusting the feeder, it is easy to control the amount of refuse that can be burned without affecting the boiler.

Corncobs Yield Intense New Sweet

A COMPOUND about 300 times as sweet as sugar has been evolved from corncobs by Dr. Henry Gilman and A. P. Hewlett, organic chemists at Iowa State College. Should this new compound prove to be harmless to the body it may become valuable as a sweetening for food for diabetic patients who cannot use sugar. The work is in a preliminary stage and the value of the new compound is undetermined, according to Dr. Gilman, who is in charge of organic chemistry at Iowa State College.

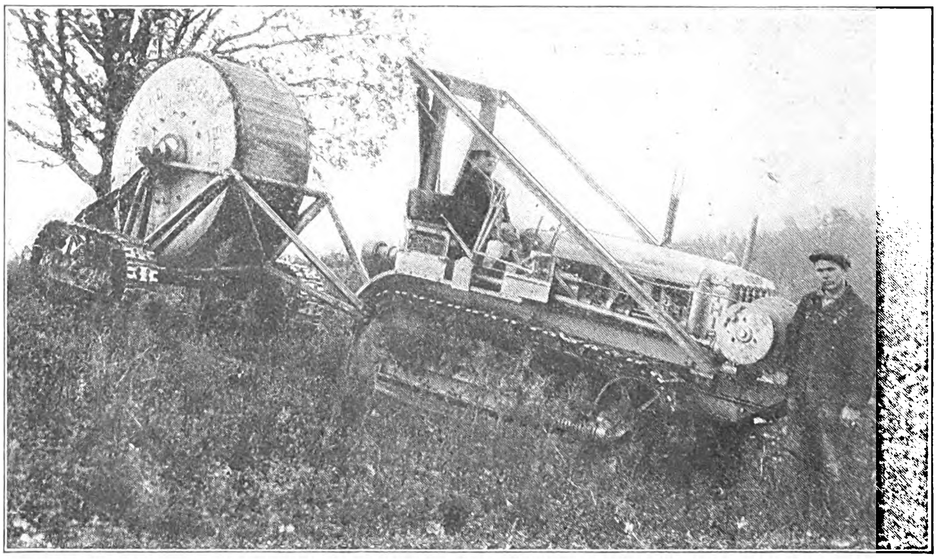
Perhaps perfume bottles and household extract bottles in the future will be filled with compounds derived from corncobs. During the past year Dr. Gilman and George Wright have produced from the corncob many new compounds which may prove valuable as perfumes and food flavors. Although physiological reactions of the new compounds have not been thoroughly determined, early tests have been most promising.

Most of the new compounds possess fruity, pleasant odors, while one especially promising compound may possibly be used for maple or walnut flavoring or as an added flavoring for coffee. Raisin, caraway, and apple flavors, also have been produced. One compound, a perfume possibility, has an odor resembling champaca, a heavy, fragrant perfume made from the flowers of an East Indian tree, while another compound these chemists have evolved has the fragrance of roses.

The work with corncobs is a part of the work with agricultural wastes being done at Iowa State College. At a recent exposition in New York a local anesthetic, the hydrochloride of diethylaminoethyl-beta-furylacrylate, developed by Dr. Gilman and associates, was shown. This anesthetic, prepared from corncob material, is approximately as effective as novocaine.—*Science Service.*

Minced Sea-worm Turns into Family

CUT most animals up and they simply die. Cut up lineus, a sea-worm common along the Atlantic coast, and it merely turns into a family of little lineuses. How it survives this terrible surgery was told before the National Academy of Sciences recently by Professor W. R. Coe, of Yale University.



Five-ton cable reel trailer built by the Highway Trailer Company of Edgerton, Wisconsin. The drum on the front of tractor pulls in underground steel-armored cable and also loads reels on trailer by means of a cable through the "super-structure" pulley. This equipment is useful in rugged sections

Slices cut clear across the body, at any place back of the creature's brain, turn into little replicas of the original worm, regenerating such organs as the cutting deprived them of. If one of these slices is split in two, or even in four, each of the bits will still organize itself into a small but perfect worm.

Queer things begin to happen if a transverse slice is partly split lengthwise, leaving the pieces attached to each other by one edge. If the free ends are toward what was the head of the original worm each piece will develop a new head, but all of the pieces will keep the same tail. If the free ends are towards the tail, the new worm will have one head and several bodies. The urge towards normalcy remains strong, however, and as a rule the partly attached worms with independent heads will pull loose and set up in business, each for itself, while the one-headed, many-bodied individuals either separate in like manner or else absorb the supernumerary bodies into one dominant individual.—*Science Service.*

Enlargements From Amateur "Movies"

A RECENT issue of *Filmo Topics*, the Bell & Howell Company publication for amateur "movie" makers, announced a new enlarging device which gives promise of answering the oft-repeated question—"How can I get good enlargements from my 16-millimeter films."

The device, which is used in conjunction with any Filmo projector, produces very creditable enlarged negatives, two and one-quarter by three and one-quarter inches in size, with a minimum of effort on the part of the operator. It may be used under any light, natural or artificial. No dark-room is necessary.

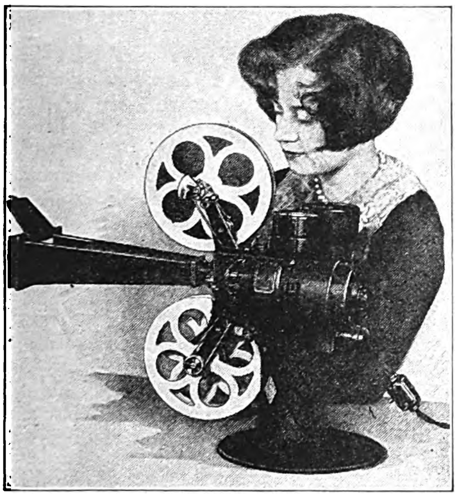
The Filmo enlarger consists of a tapered box at the small end of which a special fixed-focus enlarging lens is mounted. The regular projection lens is removed and the enlarger is slipped onto the projector in such a way that the enlarging lens replaces the regular lens. A bayonet-like shaft on the enlarger comes into firm contact with the projector aperture plate and automatically focuses the enlarging lens. A set screw locks the entire unit firmly into place.

A film pack adapter, supplied with the enlarger, is loaded with a pack and slipped into place at the large end of the tapered box. The hinged cover at the top of the box is then raised so that the film may be viewed as it is projected upon the white surface of the film pack adapter slide.

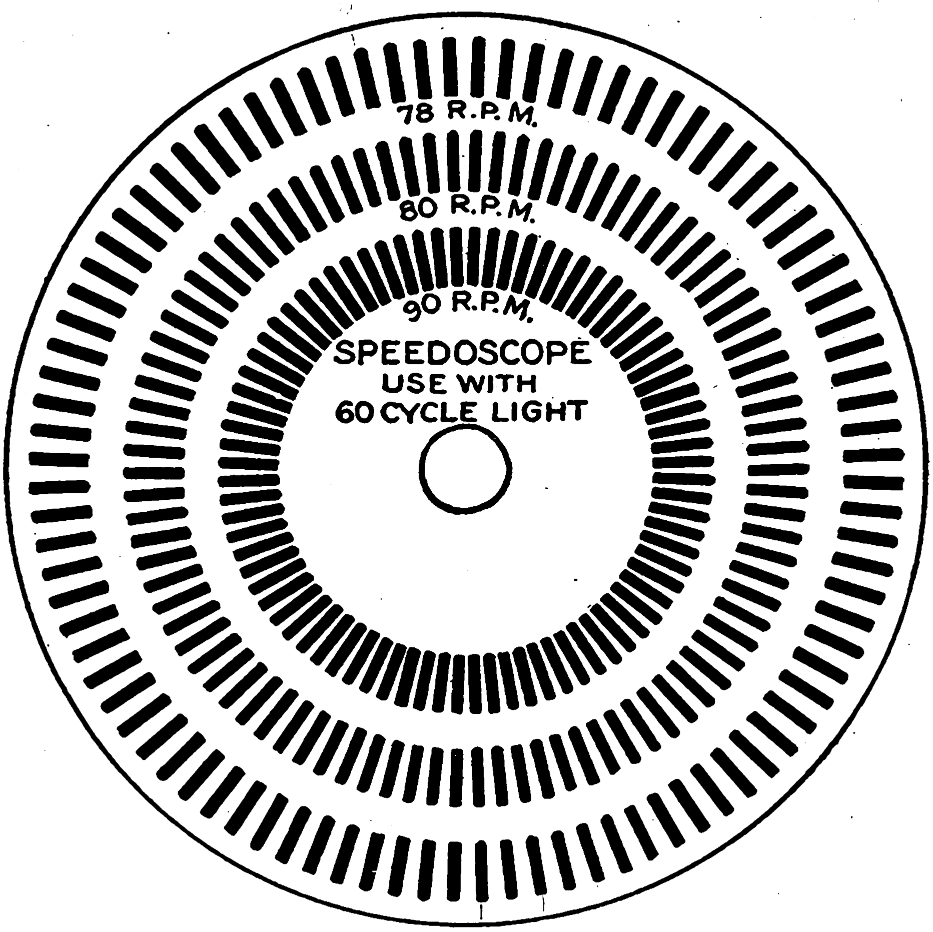
When a scene from which an enlargement is desired appears upon the screen, the projector clutch is disengaged, the enlarger shutter closed, the pack adapter slide removed and the picture is projected just as one would project a single frame upon a screen. Then the enlarger shutter is pressed, giving an instantaneous exposure and producing a properly timed negative from any correctly exposed frame of reversal or positive film.

Phonograph Speedometer

PHONOGRAPH records are cut at a certain speed of the revolving wax disk. Reproduction at the true pitch can therefore be expected only if the record is turned under the pick-up at exactly that same speed. Victor records, for example, are cut at 78 revolutions per minute, Brunswick and Edison at 80 revolutions per minute, and some foreign records at 90 revolutions per minute. An electric motor or a spring is the driving power for reproduction, both of which are equipped with a mechanical speed regulating device, based on the brake principle. Gradual wear of this brake prevents a once properly adjusted speed being maintained for an indefinite period. The manufacturers recommend, therefore, that the speed of the turntable be checked occasionally by fastening a strip of paper to the record, and counting revolutions with the aid of a watch—a very uncertain method at best.



Enlargements from amateur "movies" may easily be made with the attachment shown



Cut this out or trace a copy of it for determining the speed of your phonograph. Speedoscopes for other speeds than those shown may be calculated

The following electrical method is recommended to all owners of a phonograph:

Cut out the accompanying circular disk including the hole in the center. Place this paper disk on a record while it plays, in a room illuminated with an ordinary tungsten filament lamp, operated from a 60 cycle alternating current supply. If a Victor is to be played and its speed is correct (78 revolutions per minute), the outer row of lines will appear a *stationary* circle of gray bars. If the record runs too fast, the bars will appear to move slowly in clockwise direction; if too slow, counter-clockwise. The action will be less pronounced if very high wattage lamps are used in the room, but even with the light of a 150-watt lamp it will be sufficiently plain to see *at a glance*, whether the speed is correct. Lamps of 25 to 40 watts are best. For Brunswick and Edison records the middle circle should be watched, while the inner row is for records requiring a speed of 90 revolutions per minute. After checking the speed it is a simple matter to adjust the phonograph to run at the desired speed by turning the speed regulator with which each phonograph is equipped.

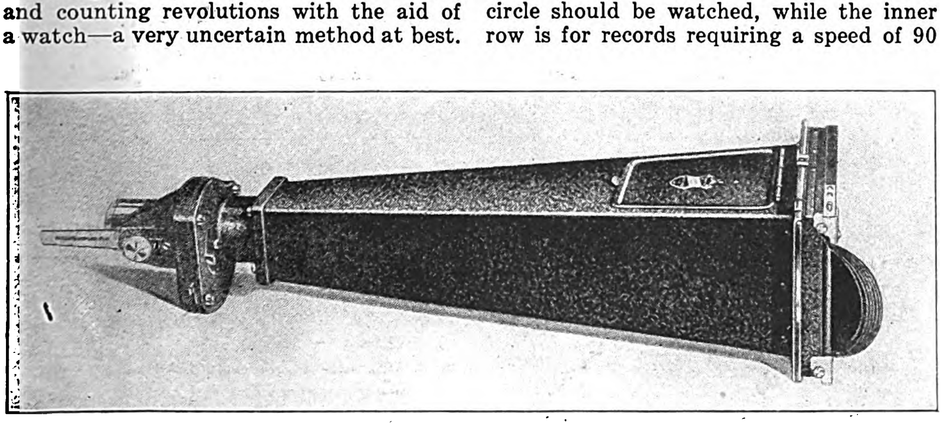
The principle of this convenient speedometer is, of course, the stroboscopic action between a correctly chosen number of equally spaced black and white bars and the otherwise unnoticeable light fluctuations of electric lights operated by alternating current. For 60 cycle light the foreign circle contains therefore 80 black bars, corresponding to 90 revolutions per minute, the Victor circle has 92 black bars, while 90 bars are contained in the Edison and Brunswick circle.

A rather startling effect is obtained if this revolving disk is illuminated with either a spark gap, an arc light or a neon lamp. Having no thermal inertia, these illuminants actually give zero light while the current passes from plus to minus, which makes the disk apparently stand still with bold black and white bars, while Mazda lamp light shows a distinct accumulation of stationary gray bars, a mixture of black and white.

It is believed that the stroboscopic effect was first demonstrated by Mr. J. B. Taylor, and the simple disk, shown in this article, was later perfected by Mr. T. A. E. Belt.

For direct current operated light the device is obviously useless. On the other hand, it is readily possible to design a similar disk for any other frequency, or any other desired speed according to the formula

$$\text{Number of Black Bars} = \frac{\text{Frequency} \times 2 \times 60}{\text{revolutions per minute}}$$



The device for making enlargements of amateur "movies." It consists of a tapered box through which the film is projected until the proper picture is visible. A film pack is then fitted and the picture is projected thereon

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

A New Cooling System

ROUGHLY speaking, one third of the heat developed in an internal combustion engine has to be dissipated by cooling, if the internal walls of the cylinders are to be kept at a safe temperature. In an engine of large power, the heat to be dissipated is enormous—millions of thermal units per hour. That is why the radiator of a water-cooled engine has to be so large, and because it is large, it weighs a great deal and offers an enormous head resistance.

The rate at which a radiator can dissipate energy depends on its design, on the speed of the air rushing through it, and on the temperature difference between the hot water in the radiator and the cool air.

When water is used as the circulating medium, its temperature must not exceed 180 degrees, Fahrenheit, or there is the risk of the water boiling away.

Quite frequently other cooling media have been suggested. Some authorities have worked out the possibility of an evaporative system, with water converted into steam. Such systems are apt to be somewhat complicated. Other suggestions have been in the direction of using a chemical other than water and having a higher boiling point. With such a cooling medium a higher temperature than with water is allowable; hence there will be a higher temperature difference between liquid and the air, and consequently a smaller radiator may be used.

The Army Air Corps engines have made some apparently very successful experiments with ethylene glycol, commercially termed Prestone, the boiling point of which is so high that its outlet temperature may be 300 degrees, Fahrenheit. If the air is at 60 degrees, this gives a temperature difference of 240 degrees instead of 120 as with water. Quite a number of flights have been made with a Curtiss pursuit plane, mounting a Curtiss D-12, 400 horsepower engine. The maximum temperature of the fluid was found to be 270 degrees after ten minutes of full throttle operation. The radiator employed was only one third the usual size, and the weight of the airplane was also reduced by some 90 pounds.

Ethylene glycol is not a newly discovered compound. It is largely used as an anti-freeze mixture in automobiles and is obtainable at reasonable prices. "It is the first and simplest of the class of polyhydric alcohols. It is a clear, colorless, odorless liquid and has a slightly sweetish taste. Its chemical formula is $CH_2OH.CH_2OH$."

A number of minor difficulties appeared. Joints and packing glands had to be tighter than with a water system. The expansion is greater than that of water, so the expansion space has to be larger. There is a tendency to soften the rubber lining in the hose connections. The oil temperatures ran high, a problem which can be solved by using a different oil or an oil cooler.

These difficulties are sure to be overcome and it is possible that a great improvement is to be provided for our aircraft.

The Helicogyre

THE Autogyro of Senor de la Cierva has achieved great success from the point of view of low landing speed and short run after landing. Whether its efficiency at high speed can be made as great as that of the airplane is a question. Its main difficulty at the moment is that it takes a long run and a long time to take off. If to the present good qualities of the Autogyro could be added a short get-away run and a quick take-off it would be an absolutely ideal machine for flying from or to restricted territory. Now an Italian inventor, Signor V. Isacco claims to have gone a step farther with his Helicogyre, in which the automatic rotation of the windmill or rotating blades is replaced by blades which are driven by engines and propellers placed at the tip of each blade.

Although Signor Isacco has presented a paper before the Royal Aeronautical Society, complete information is not as yet available. The new type of aircraft is illustrated in the diagram.

It embodies a conventional fuselage, landing gear, and tail surfaces. At the nose of the fuselage is mounted an Armstrong-Siddeley Genet engine of 75 horsepower, driving a conventional two-bladed propeller, so that forward movement is obtained just as in the airplane. Instead of the usual wings, however, two large blades are used, one on either side of the fuselage. The blades are free to rotate about a vertical axis. At the point of connection to the vertical axis, these blades are so articulated that they can move up and down in the direction of the lift, and are also so articulated that they can move slightly back and forward.

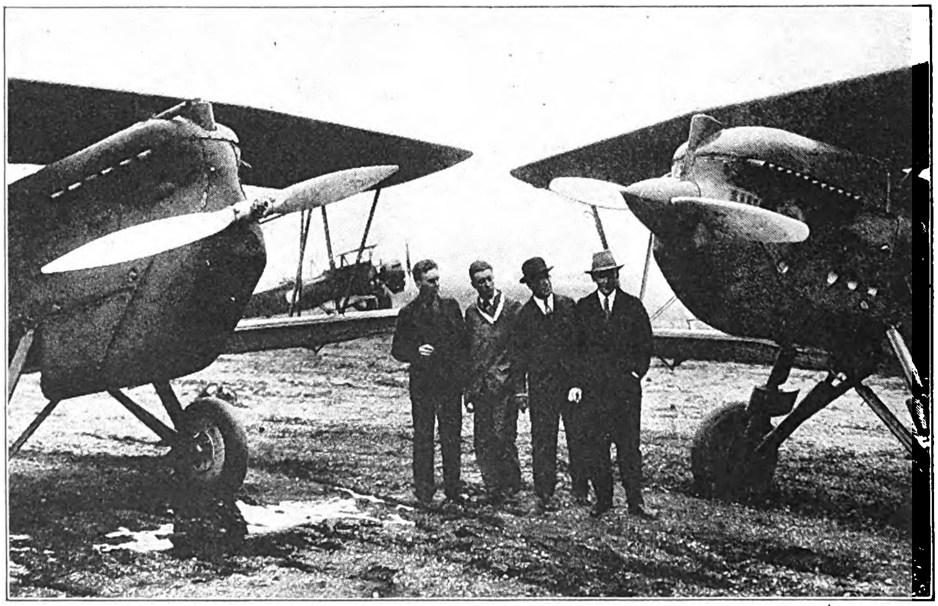
At the ends of the blades are mounted two Bristol Cherub engines of 32 horsepower, each driving its own propeller. It is the thrust of these auxiliary propellers which pulls the large blades around. The rotating blades are provided with ailerons and for hovering control two small surfaces are fixed to the fuselage. The gasoline tanks for each of the small engines are mounted inside the wings. The machine illustrated in the diagram, which is the second one to be built, weighs 1320 pounds and rose into the air several times using only 50 horsepower. The machine is only in the preliminary test stages.

A number of questions immediately suggest themselves.

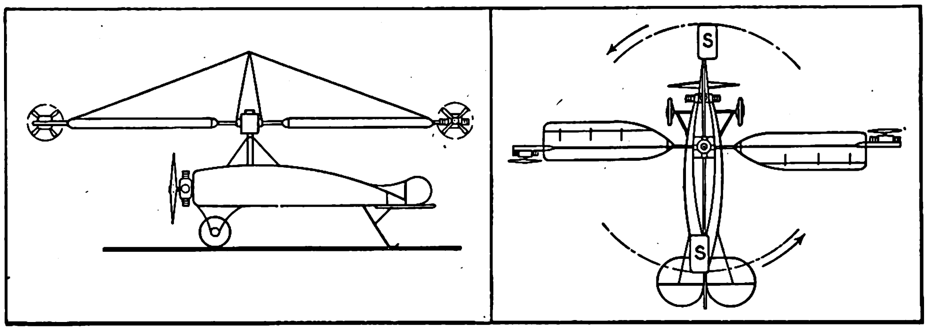
Can the Helicogyre rise vertically into the air? There seems to be no reason why it should not. By using wing-tip engines, the gearing and transmission weights of the helicopter are avoided and the gross weight can apparently be kept at a reasonable figure. The weight per horsepower of the wing engines is not much over 20 pounds, and a lifting airscrew can readily operate at this load.

Can the machine achieve forward motion? There is no reason why it should not. The forward propeller has sufficient power behind it for propulsion, and the propulsive effort can evidently be increased by tilting the central axis forward, in which case a component of the lift of the blades will act forward.

Will the craft be stable laterally? With a single rotating surface, the blade going into the wind (when there is forward mo-



Left: A Curtiss Falcon with a D-12 engine, water cooled. By using Prestone for cooling, the radiator on the ship at the right has been reduced in size



Redrawn from *Flight*

Side and front views of the Helicogyre, the latest effort toward vertical ascent and descent in heavier-than-air craft. Engines at the tips of the horizontal blades cause them to rotate, and another engine drives the plane forward

tion) is evidently receiving a speedier relative wind than the blade moving away from the wind. But just as in the Autogyro, the blade moving into the wind should move up, and thereby have its angle of incidence diminished, while the blade moving away from the wind should move down and thereby change its angle of incidence. Therefore there is good hope of lateral balance.

Should the machine be able to land slowly? It certainly should with the auxiliary engines functioning. Even if the forward propeller and the side engines quit, there is no reason why the blades should not continue to rotate in windmill fashion and give a landing as good as the Autogyro.

The answers to these questions might (if they appear reasonable) lead the reader to believe that the Helicogyre is the ideal aircraft. Unfortunately it also appears to offer many difficulties.

Control in hovering or vertical ascent is extremely difficult and it does not appear that the small surfaces marked *S* in the diagram will be at all sufficient to secure control. In vertical ascent the craft may be largely at the mercy of contrary gusts.

The lifting windmill of the Autogyro has a far lesser lift-over-drag or efficiency ratio than a good airplane wing. It does not seem likely that the rotating system of the Helicogyre will be any better. The propellers of the auxiliary engines will be working under varying aerodynamic conditions, and while the propeller on one side will be pulling back, the propeller on the other side will be pulling forward. The over-all efficiency is likely to be very low.

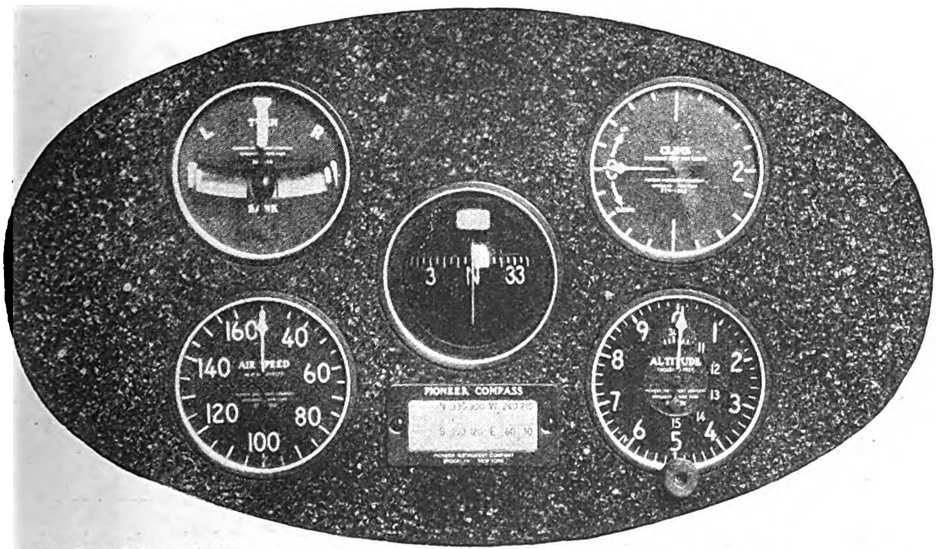
The difficulties experienced with the old rotary engines have led to the entire disappearance of this type. The difficulties due to centrifugal force and possible unbalance with the engines rotating at the end of a long arm are likely to be still greater. Since the auxiliary airscrews are going to work at rapidly varying conditions, vibrations in the auxiliary engines are quite possible.

When considering radically new types of aircraft, we must also remember that the airplane with the assistance of slots and flaps is gradually approaching the ideal condition of short landing runs and short get-aways.

Dr. Whimperis of the British Air Ministry has said, however, when discussing Isacco's device "But the greatness of the difficulties in the path adds to the zest of the adventure. The potentialities of the rotating wing must be explored and they will be explored. We cannot go forward with the conventional type of airplane with complete confidence that we are on the right path, if we leave behind us uninvestigated the potential qualities of the rotating wing."

A Flush Instrument Board

IN many accidents of comparatively minor character, pilots have been seriously injured by being pitched forward on the instrument board, and particularly on projecting parts of the compass. The remedy lies in providing padding above and around the instrument board, the padding to project forward. Another helpful factor is to design the instrument board so that it presents a flush or smooth surface. A small Pioneer instrument panel is shown in our photograph, where all the instruments including the magnetic compass are flush with the board.



Courtesy Pioneer Instrument Company

Possibility of injury from instruments in a crash is reduced by this new instrument board, in which the units are placed flush with the front oval panel

The Lehigh Airport Competition

COLONEL CHARLES LINDBERGH has recently stated that American airports are not up to European standards. We believe that this condition is due to the fact that only recently have American operators undertaken to carry passengers, and that the special facilities and precautions necessary when passengers are carried will be provided almost as a matter of course. The Department of Commerce has been doing very useful work in the improvement of airports by providing ratings and laying down general rules for their design. The Lehigh Airports Competition, sponsored by the Lehigh Portland Cement Company, is certain to elicit some novel designs and suggestions. The prizes offered are a first prize of 5000 dollars, a second prize of 2500 dollars, a third prize of 1000 dollars, a fourth prize of 500 dollars; and ten honorable mentions carrying awards of 100 dollars each.

Each competitor is to assume a sea-level airport of sufficient size to provide an effective landing area of 3500 linear feet in all directions. The circular announcing the competition states that at present planes are not designed for operation on grades greater than 2½ per cent. This statement may be criticized, but certainly operations are facilitated by an approximately level site. The average airplane of to-day may be assumed to have a gliding angle of 1 in 7. The competitors are to assume accordingly that structures of 50 feet in height may be found at the outskirts of the field, and that a marginal strip all around the flying area of 350 feet in width will be required.

The entire field is to be enclosed with a fence which will prevent the access of unauthorized persons to the flying area. As air traffic increases, more and more precautions of this character will have to be observed. At present anyone can stroll into and upon the flying area at will, with hazard to himself and inconvenience, to say the least, to pilots.

Because of the practical limitations in cost of developing a suitable all-over surface for a large flying field, it is now customary to provide paved runways, each not less than 100 feet in width, for landing and take-off. The competitors are to indicate on the plan of the field an arrangement for such runways, giving safe landing under all ordinary conditions of wind and weather. Adequate lighting facilities are of course to be provided.

Only a year or so ago an airport was considered well nigh perfect if proper landing and lighting facilities were provided. The authors of the competition now call for innumerable "accessories."

In the marginal strips, space must be provided for parking automobiles and for mooring planes. Easy transportation facilities, other than by air, are now considered essential. Passenger concourse and waiting room of 2500 square feet are to be indicated on the plans, with ticket wickets, office space for traffic manager and officials of at least four air transport companies, and all the normal accessories of a railway passenger station. "An important essential is to provide safe access for passengers, protected from the weather, to the loading point for transport airplanes." There must be suitable hangar facilities for plane repair and space for fire apparatus, ambulance, and so on. A hotel and concessions are to be incorporated in the plans.

It is extraordinary to think that such a competition is in being to-day. Three short years ago it would have been regarded as visionary.

Eaglerock Bullet

AIRPLANE designers are always striving to reach the ideal aircraft which shall be nothing but a flying wing. One of the steps in such evolution is the use of a retractible landing gear. Retractible landing gears have been frequently used in racers and in amphibians. There is reason to believe that they will also be employed in ordinary commercial landplanes.

Three quarter view of the neat looking Eaglerock Bullet

Indeed, the Alexander Aircraft Corporation has already brought out a four passenger cabin monoplane, the Eaglerock Bullet, in which a retractible landing gear is successfully employed. The method of retracting the landing gear is said to be quite fool proof. Whether up or down its condition is always apparent to the pilot. A hand wheel on the front wing beam is used to draw up the gear into specially designed compartments, and when the gear is retracted the underside of the fuselage is completely streamlined. Equipped with a Kinner 100 horsepower engine and carrying four passengers, the Bullet has attained a high speed of 130 miles per hour. Our photographs show the clean appearence of the "Bullet" with its gracefully tapered, cantilever monoplane wing.

Airplanes Make Pastures of Cutover Timber Lands

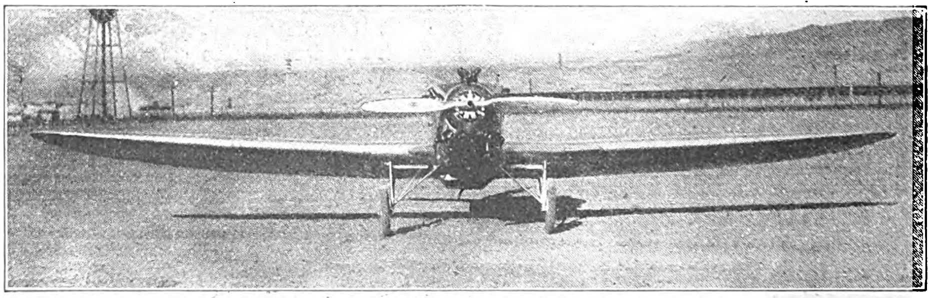
AIRPLANES are making the desert blossom, if not exactly as the rose, at least as first-class pasture land, in large areas of cutover timber land in the Pacific Northwest. They have added to their already long list of accomplishments the rôle of broadcast sowers of grass seed, and the first experiments have shown them to be much more successful and rapid than hand workers, as well as more economical.

Timber companies in the Northwest have found the problem of the large areas of stripped lands left on their hands after logging operations a serious one. The most economical use appears to be to burn the "slash" and then sow the area in grass and use it as sheep or cattle pasture. But the land is for the most part very broken and rough, and men on foot have a hard time seeding it. This method proved to be so slow and expensive that it has been employed only where conditions were ideal.

One corporation hired a plane and pilot from a commercial flying company. A special hopper was built for releasing the grass seed, which was spread out in a wide stream by the propeller blast. Flying fairly low across the newly burned-over land, the plane sowed the grass seed into the loose ashes, which served as a receptive and well-fertilized seed bed.

One plane was able to sow from 150 to 200 acres of rough land a day. The best that a man on foot can do over similar terrain is five to eight acres a day. Even counting the high cost of plane hire or ownership, the flying method of sowing is by far the cheaper, averaging 40 to 60 cents an acre, as against a cost for hand sowing of 75 cents to $1.25 per acre. Moreover, plane sowing requires only six or eight pounds of seed per acre, while the hand method uses ten or twelve. Since grass seed costs from 30 to 35 cents a pound wholesale, this item is not inconsiderable.

The work of sowing over broken ground is not without its dangers. The planes have to fly fairly close to the ground, and the broken surface and frequent deep side ravines cause all sorts of treacherous air currents. The aviator has to be constantly on the alert, for a forced landing would almost certainly mean a crash. However, all the work to date has been accomplished without accident.—*Science Service.*



Front view of the Bullet. The chassis can be retracted into the fuselage

Our First Army Pilot

IN THE article "Builders of the Aviation Industry" appearing in our March issue, it was stated that Brigadier-General Benjamin D. Foulois is "the first army air pilot in point of service." When exception was taken to this by a reader, we wrote the Army Air Corps and the following is a part of the reply we received:

> ". . . the Chief of the Air Corps has directed me to inform you that General F. P. Lahm was the first army officer to pilot an airplane, General B. D. Foulois was the second Officer to receive his flying training. Neither of these officers have, however, been continually with aviation since they finished training so that from the point of view of continuous aviation service it is believed that Major T. D. Milling has served longer than any other officer."

How Long Will An Engine Last?

A. H. R. FEDDEN, a British Designer, lecturing before the Royal Aeronautical Society, recently gave some remarkably interesting statistics on the life of aircraft engines.

On the Imperial Airways lines in the Middle East, where Bristol Jupiter engines of approximately 450 horsepower are employed, the following figures apply:

Average hours operation per engine	469 hours
Maximum recorded hours, one engine	960 hours
Average hours between overhaul	400 hours
Average man-hours for overhaul	1356 hours

On the K. L. M., or Royal Dutch Air Lines, operating between London and Holland, using the Jaguar engines:

Average hours between overhauls	400 hours
Average man-hours for overhaul	480 hours

For the Wright Whirlwind of 200 horsepower, Mr. Fedden secured data from nine different operators:

Average hours operation per engine	401 hours
Average hours between overhauls	290 hours
Maximum recorded hours on one engine	2000 hours

These figures show a vast improvement over those of three or four years ago.

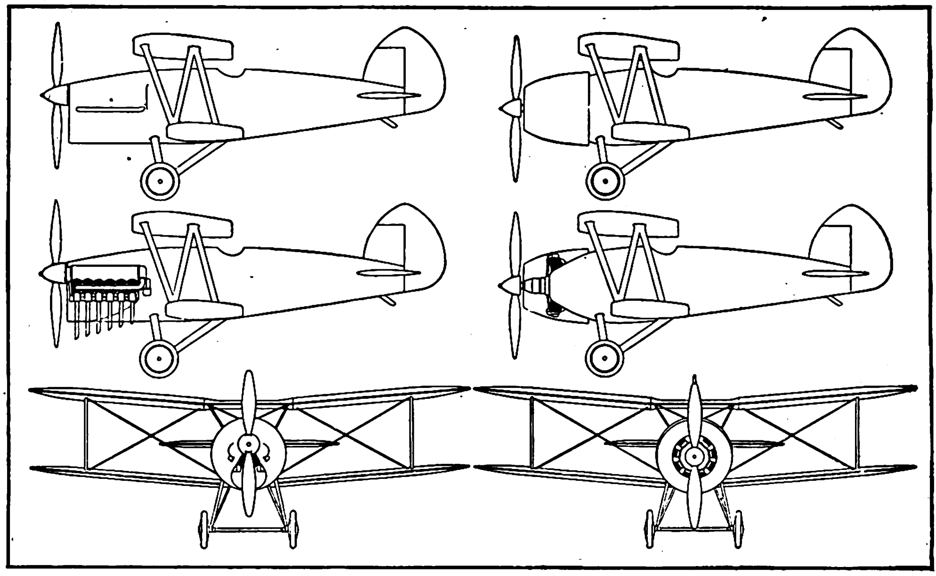
For Cirrus engines used by English light-plane clubs, the data secured are as follows:

Average hours operation per engine	290 hours
Maximum recorded hours on one engine	403 hours
Average hours between complete overhaul	360 hours
Man-hours for top overhaul	25 hours
Man-hours for complete overhaul	100 hours

The figures for the Cirrus are of particular interest to our own flying clubs who will use engines of similar power, and who from reliable experience such as this should be able to compute the running and depreciation costs of their engines with accuracy.

In the same paper, Mr. Fedden also discusses the relative merits of the radial air-cooled engine and the in-line air-cooled engine. The diagrams illustrate installations with a 12 cylinder in-line engine and with a nine cylinder air-cooled job.

The exponents of the in-line engine stress its smaller head resistance. But by completely enclosing the radial engine with suitable cowling, allowing an opening at the center as shown in the diagram, the head resistances can be put on a footing of equality with the in-line type. In the large airplane where the body is necessarily of big dimensions, the radial may actually score in head resistance, because there must be a big air-resistance-producing body, regardless of the engine used. Further, with the radial engine, cooling will be less of a problem because all the cylinders are equally exposed to the air blast. There is no rear part of the engine to receive air which has already been warmed by the first cylinders. Again, the radial engine has the advantage of light weight and compactness. In spite of the growing popularity of the in-line engine, evidently the controversy over the two types is far from being closed.

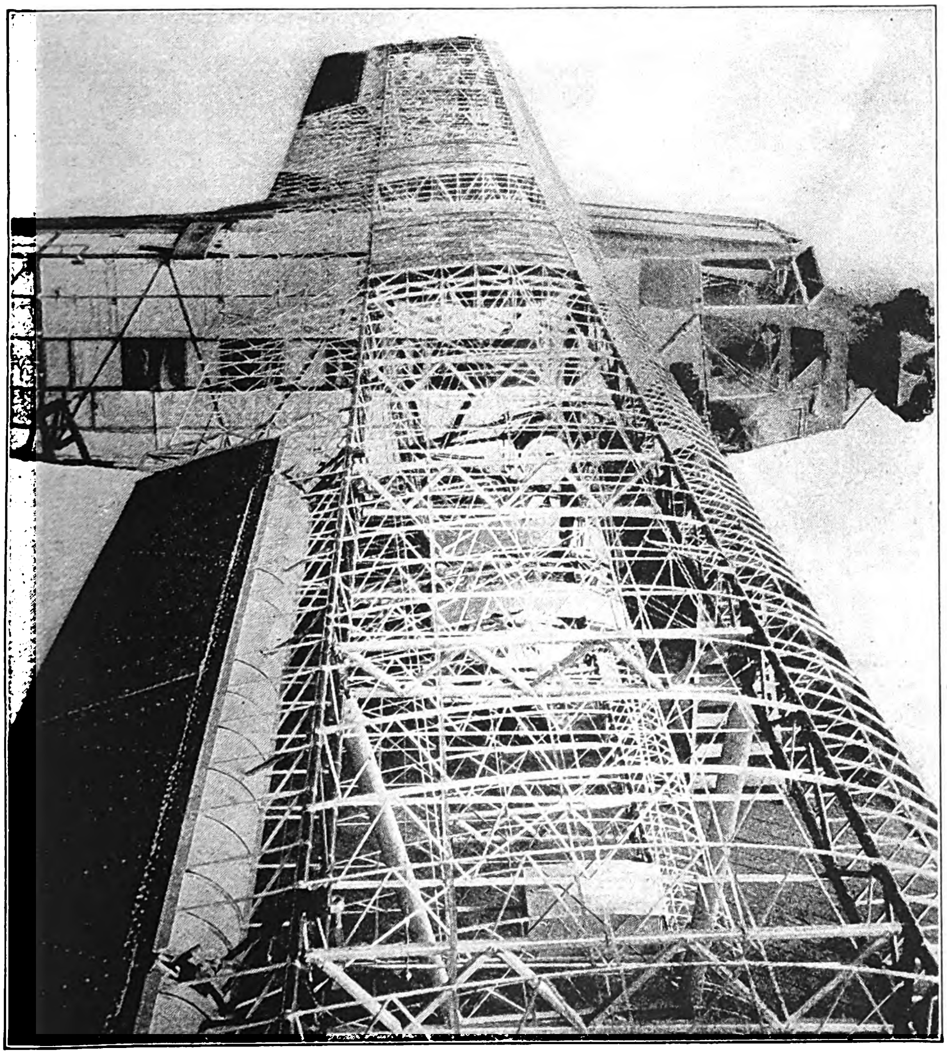


The illustrations in the vertical row at the left are of a 12-cylinder "V" type water-cooled engine. At the right are similar views of a 9-cylinder totally inclosed air-cooled engine. See article on the opposite page and at the left

The Boeing 80-A

COLONEL LINDBERGH thinks that larger and larger planes will be needed for passenger air transport, and that four-engined planes are likely to come soon. In the meantime quite a number of large three-engined planes are already in use or in process of construction. One of the most interesting of these is the Boeing 80-A, a twenty-place cabin monoplane of the following characteristics. Length overall, 55 feet; height overall, 15 feet 2 inches; upper wing span span, 80 feet; lower wing span 64 feet 10 inches; wing area 1220 square feet. The useful load is 7133 pounds and the gross weight fully loaded is 16,500 pounds. Powered with three 525 horsepower Hornets, the high speed is 135 miles per hour, and the initial climb 900 feet per minute.

Our photograph is unique in showing the airplane apparently complete but without covering on wings or fuselage. It will repay careful study. What is at first glance a meaningless maze is on the contrary a beautiful and instructive view of the structure of a modern airplane. Looking at the upper wing we see that the spars are built up of two steel tubes with welded diagonal tubes in between the two tubes forming the upper and lower flange of the girder. The ribs are also in the form of an engineering truss, apparently with square dural channels. The interplane struts are of streamline steel tubing. Swaged tie-rods are used in the internal truss of the wing. The huge ailerons are apparently covered with sheet dural and are supported on brackets from the rear spar.



A most unusual view of a three-engined ship without the wing fabric in place. Only the ailerons are covered. Notice the maze of cross braces and struts

Airport Sign and Signal

A COMBINATION sign to attract visitors to the airport, and to serve as a signal for pilots in the air has been constructed at the Visalia, California, airport by A. A. Clark, director of the aeronautics division of the Visalia Chamber of Commerce. This signal consists of a canvas curtain that may be marked with any device that is desired. When a rope is pulled, the curtain rolls up on a roller under a metal hood which also serves as a housing for the reflector and electric light bulbs. Signals may be seen by night or by day and several rolls may be accommodated.

VISALIA AIRPORT
CLEANEST
Most Satisfactory Way
To Travel.

Advertising the airport

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Sudden Death of Motorists

NOT infrequently newspapers report cases of sudden death in drivers of motor cars. In most of these instances, the persons in apparently good health have started out on a drive and have been found dead in their car by the roadside. In other instances, cars have toppled into ditches and into rivers due to the sudden death of the drivers. Physicians in Chicago have recently published three instances of this character. A man aged 65 was driving an automobile which was suddenly noticed to be going from side to side and finally to go off the embankment and turn over. A post-mortem examination revealed changes in the heart which indicated that death had occurred from heart disease before the car went off the road. Although blood was found under the scalp, there was no fracture of the skull and no hemorrhage or other abnormal change in the brain.

In the second case, a man aged 67 was driving a motor car over a dry concrete road. People in the following machine noticed that the car suddenly began to zigzag; finally it left the road and turned over in a shallow ditch. First inspection indicated that death had resulted from a skull fracture and injuries to the brain, but when a post-mortem examination was made, the skull fracture was not found, the brain was uninjured, and sufficient changes were found in the blood vessels and heart to indicate that death had occurred suddenly from stopping of the heart.

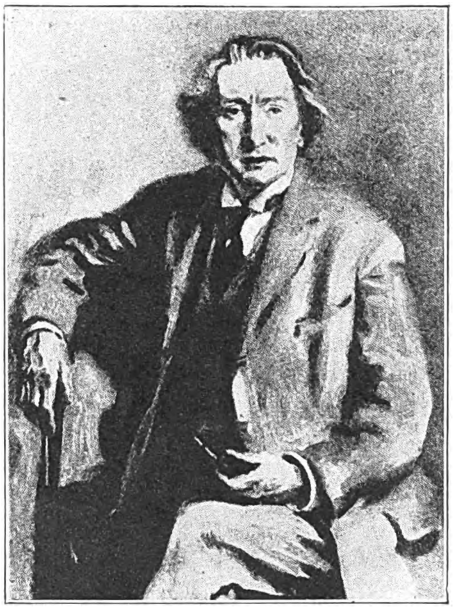
It is pointed out that people who die from such changes in the heart sometimes die sitting upright in a chair, on the seat of some public conveyance, and frequently so quietly that other people sitting nearby are unaware that death has occurred.

Numerous instances of this kind that are available in medical records are still further indication of the necessity for some sort of physical examination for people who drive motor cars, particularly in congested traffic of great cities.

How Gilbert, American Composer, Conquered Heart Disease

ONE does not usually search in medical periodicals for extraordinary biographies or for the records of noted musicians. Nevertheless, the true story of the life of Henry F. Gilbert has been told in such a periodical by his physicians, Drs. Paul D. White and Howard B. Sprague, and it constitutes one of the most inspiring documents that has thus far been made available relative to those who have conquered their handicaps and lived lives of usefulness to humanity.

Henry F. Gilbert, the American composer, was born of old New England stock in Somerville, Massachusetts, on September 26, 1868. His father was a composer and organist and his mother was a singer. At birth he suffered with certain defects of the heart which were to control him during his entire life. These defects involved narrowing of some of the valves of the heart, a defect in the tissue that divides the heart chambers, an enlargement of the right ventricle of the heart which is especially concerned with forcing blood throughout the body, and an unusual position of the large blood vessel leading away from the heart. This combination of conditions has been named the "tetralogy of Fallot" after the famous French physician who first described it in 1888. Associated with the condition there is enough interference with the circulation of the blood to cause clubbing of the fingers so that they are very broad at the tips and also a general blueness which is particularly marked over the cheek bones.



Portrait of Henry F. Gilbert. Cyanosis of the cheeks and hands, and clubbing of fingers can be seen

Because of the interference with his circulation Gilbert was unable to play vigorously during childhood. He became easily fatigued and short of breath. Many times physicians expressed doubt that he would survive to adult life. Dizzy spells and headaches attacked him not infrequently. As he grew older he sometimes staggered like a drunken man and fainted on one occasion during a rehearsal of one of his pieces of music. As a young man Gilbert studied with Edward MacDowell, the famous musician. In 1901 when Gilbert was 33 years old he went to Europe on a cattle boat to hear the opera "Louise." He determined to devote the rest of his life to the development of American music. His "Negro Rhapsody," "Indian Sketches," and "Dance on Place Congo" are an indication of some of the themes that won for him international recognition. During his later years his heart action and respiration were improved by the use of digitalis, the drug that has been recognized as one of the great sheet anchors in the treatment of disease of the heart.

On May 19, 1928, Mr. Gilbert died in Cambridge, Massachusetts, of apoplexy. He was 60 years old and he had made of his crippled life, in the words of Dr. White, a great success. A post-mortem examination revealed the soundness of the diagnosis and the manner in which the tissues, abnormal at birth, had accommodated themselves to carrying on the life of this remarkable figure. His story should bring hope and inspiration to every other victim of heart disease.

Botulism and Home Canning

RECENTLY a meal of home-canned string beans was served to a group of Italians in Westfield, New York. Thereafter eight of the people who ate the beans became severely ill and four died, apparently from botulism transmitted through the beans.

For more than five years the *Journal of the American Medical Association*, the United States Public Health Service, and the canners' organizations have issued warnings relative to the danger of botulism from home-canned string beans canned by the cold-pack method. The departments of home economics in colleges and universities have endeavored to educate people regarding the danger.

Many of the recipes for the home-canning of vegetables antedate our present knowledge of botulism. The organism and its poison are difficult to control, and the public must realize that every non-acid vegetable should be rendered safe either by sterilization for a sufficient time and temperature in a pressure cooker, or by drying, or by the addition of 10 percent of brine solution. The only other alternative is long boiling, after removal from the glass jar, which serves to destroy much of the value of the vegetable itself. The commercial canners have learned the lesson and render their products safe by suitable steam heating under pressure during the canning process.

Mosquitoes and Horses

THE Bureau of Malarial Control of Porto Rico recently conducted a series of investigations which proved that when horses and men slept in the same house mosquitoes attacked the horses and only rarely the men. When the animals were removed from the vicinity of the house, the mosquitoes at once returned to the human diet.

A European investigator published in the *Annals of the Pasteur Institute* related investigations which indicate that the mosquito is highly adaptable to conditions that affect its opportunity to live on animal blood. Those mosquitoes which live on live stock develop stronger mouth parts than those that feed on man. If live stock is kept outdoors in a windy country, the mosquito will seek the interiors of the house and feed on the human beings in the house. However, if the animals are housed in good stables, the mosquitoes are more likely to seek them.

The control of all of the parasites that afflict mankind depends just as much on an intimate study of their natural history and the way in which they live as on any other factor.

Digestion of Meat

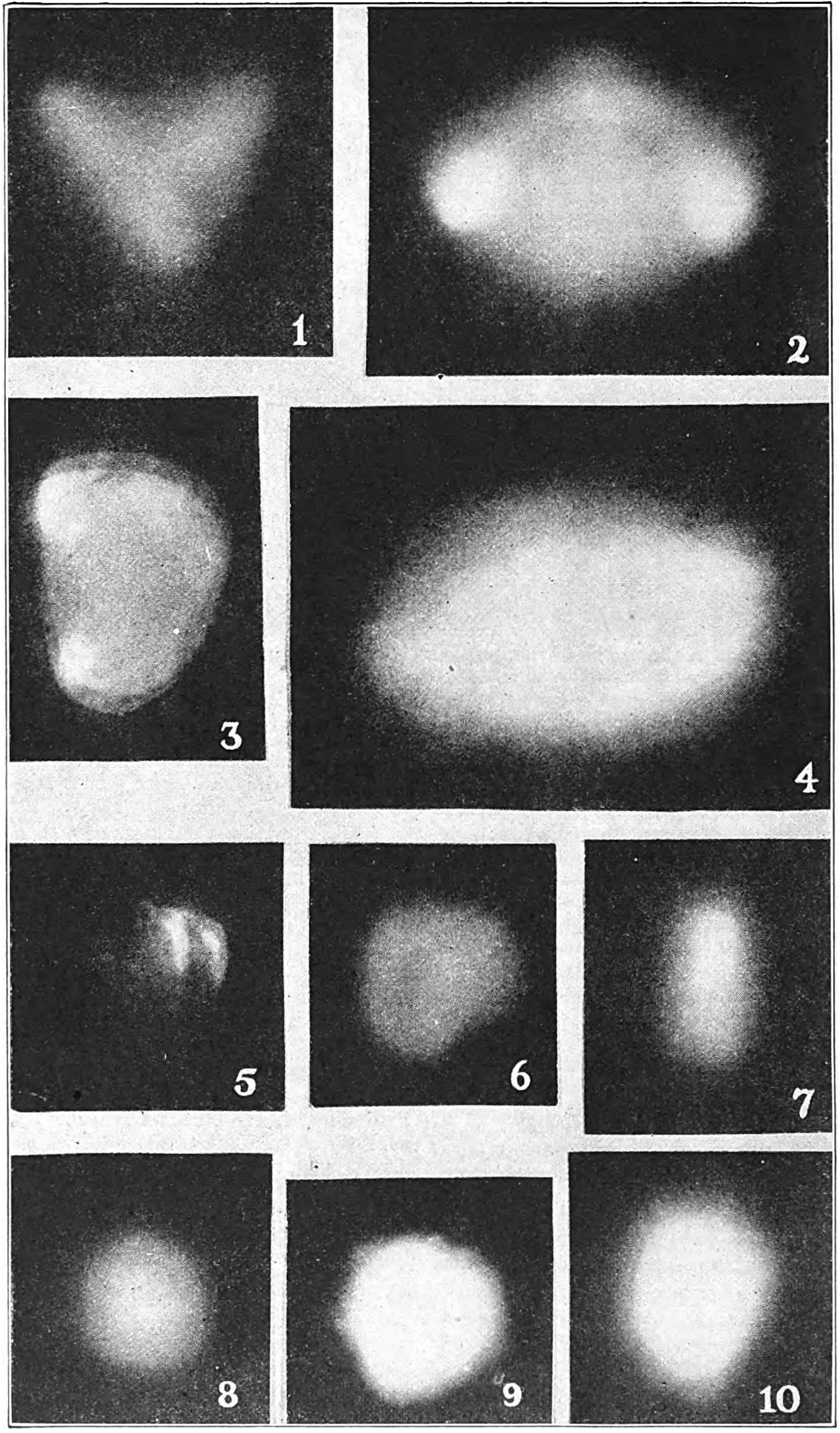
FOR some time the physiologists have emphasized the idea that meat is a sort of stimulant to the digestion in so far as it gives the stomach something to work on, in addition to providing nutriment of importance for the human body. Recently Drs. Martin E. Rehfuss and George H. March of Philadelphia have made a careful study of the gastric digestion of meat in health and in disease. They found that meat induced the highest degree of acidity in the human stomach and that the secretions of the stomach varied with meat from their reaction toward breadstuffs and cereals.

As a result of testing the digestion of meat in patients with a large variety of diseases, it has seemed to the investigators altogether probable that serious systemic diseases involving impaired function of the stomach likewise impair the ability of the stomach to digest meat. The evidence indicates that observations on the body in health cannot by analogy be carried over to the body in disease. In health, meat acts as a stimulant to the gastric function. In disease it does not act to produce a maximum response on the part of the secreting membranes of the stomach and hence must be used with considerable caution. Another advantage of the investigations has been to provide a sort of diagnostic test which will enable the physician to differentiate in the diagnosis of diseases of various types affecting the stomach.

Radioactivity After Death

WHEN radioactive substances enter the human body, there is a continuous bombardment of the tissues by the radiation, with effects on the bones and on the blood. These changes have been noted by various observers and today one exercises great caution in the use of these substances. As an indication of the permanency of effects, the observations made by Drs. A. V. St. George, Alexander O. Gettler, and Ralph H. Muller are striking.

Some years ago a number of employees in a factory in New England were engaged in painting watch dials with a mixture containing a small amount of radium and mesothorium to make the watch dials luminous. One of these employees was an unmarried Italian girl about 23 years of age. In her work she was accustomed to pointing the brush between her teeth. She developed vague aches and pains which were distinctly diagnosed as rheumatism. Her symptoms became worse and in 1922 she was found to be suffering also from syphilis. She died on September 12, 1922, and these diseases, including some inflammation of the mouth and bleeding of the gums, were assigned as the cause.



Radium rays from various tissues of the body five years after death, in a case of industrial contact with radium. 1; piece of lower jaw: 2; vertebra: 3; femur: 4; femur through lead: 5; tibia: 6; liver: 7; metacarpal bone: 8; brain: 9; lung: 10; spleen ash. For details, see also item in the column at the left

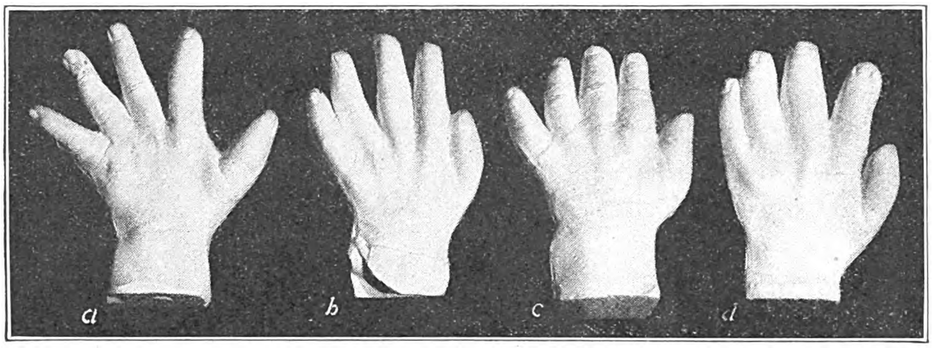
Since that time, it has been found that other employees working in industries of this character have died or become severely ill from the effects of radium. Because of the question of compensation, the body of the girl mentioned was disinterred five years after burial, a post-mortem examination made and the tissues studied for the presence of radioactive materials. Every portion of bone and of tissue tested, including the bones of the jaw, the spine, the legs, the hands, and the liver, brain, lungs and spleen, indicated the presence of radioactive material. Tests made with an electroscope and with photographic plates confirmed these observations.

Apparently radium salts taken into the body find permanent lodgment in the tissues and have a predilection for the bones. The bombardment of the bones by radium rays causes increased brittleness and eventually the death of the tissue.

Mental Excitement and Brain Stimulation

THERE are certain drugs which have the power of bringing about stimulation of the brain through cutting down the oxygen and increasing the carbon dioxide in the body. It occurred to investigators in the University of Wisconsin, working under a grant from the Ella Sachs Plotz Foundation, that it might be of value to stimulate the brains of patients with various mental disorders.

Patients with dementia praecox, melancholia, and manic depressive insanity were treated by the use of drugs that might bring about such effects and with inhalations of a mixture of carbon dioxide and oxygen. It was found that persons in the stuporous phases of certain psychoses received definite stimulation of the brain by this method, and indeed by these simple chemical procedures, the mental process in certain psychotic patients were restored toward normal for periods from two to twenty-five minutes. During these times, therefore, it was possible to ask questions and receive answers and to make other studies of the greatest importance toward yielding eventually an understanding of the nature of these diseases.



Variations in the shape of the hands in infants. *a*; long, narrow hand of the linear type of infant: *b* and *c*; intermediate types of hands: *d*; short hand with the stubby fingers of the lateral type of infant. These different types and their characteristics are discussed at length in the center column below

Drs. A. S. Loevenhart, W. F. Lorenz, and R. M. Waters, who carried out the work, found that during the periods of brain stimulation the patient would suddenly develop an intelligent appearance, hold a clear conversation and even exhibit a remarkable memory for past occurrences. Certain persons who usually had a smirk or silly grin would develop an interested expression and those who were apathetic became quite animated.

The preliminary report of the Wisconsin investigators indicates new possibilities for a solution of these important problems.

Ethylene and Vitamin Content

FOR several years it has been known that fruits and vegetables may be ripened rapidly by the application of ethylene gas. In 1927 attention was called to the possibility that such artificial ripening, while it served to hasten the coloring of the fruit and vegetables, might interfere seriously with their vitamin content. In 1928, investigators showed that celery bleached by ethylene does not differ in vitamin B content from ordinary celery, but recent investigations by chemists in the Iowa Agricultural Experiment Station bring out new facts regarding the vitamin content of tomatoes.

No difference was found in the vitamin B content of tomatoes—green, air ripened, ethylene ripened, and vine ripened. The vitamin A content of ripened tomatoes was found to be greater than that of the green mature fruit, and the same quantity of vitamin A was developed in the tomatoes regardless of the method of ripening employed. Green tomatoes were found to be relatively poor in vitamin C content. Air ripened and ethylene ripened tomatoes were richer in vitamin C than was the green fruit. Vine ripened tomatoes, however, contained more vitamin C than either green or artificially ripened tomatoes.

Moreover, a research in the Michigan State College brought out the fact that vitamin A is present in green asparagus, whether freshly cooked or canned, but that bleached asparagus does not contain enough of this substance to prevent death in white rats that are undergoing vitamin A starvation. This observation is easily correlated with other studies indicating that the coloring matter of plants is associated with the vitamin A content.

Body Builds of Infants

ACCORDING to the Drs. Bakwin of the department of diseases of children in Columbia University, children are of two types—long and wide. More and more physicians are beginning to consider the relationship of the constitution and body build to the development and nature of the human being. It has long been recognized that boys die in much larger proportion during the first year of life than do girls, and that the male is apparently more influenced by environment than is the female.

Grown-ups have been classified in all sorts of ways. The geneticist, C. R. Stockard, has introduced the classification of linear and lateral types. The linear type has a long head, a high narrow nasal bridge, sharp prominent nose, narrow mouth arch with teeth that are usually ill set, small poorly-developed lower jaw, long thin neck, long slender extremities, and slender bones and muscles. In such people the stomach is vertically placed and long and narrow, and the intestines short and active. The linear type of person has a thin skin and tends to be underweight.

The lateral type has a broad head, a wide and low nasal bridge, prominent strong lower jaw, short neck, rounded shoulders, large bones and, in fact, tends to be the opposite of the linear type. In the lateral type of person the stomach and intestines are long and sluggish, and he tends to be overweight.

Many psychologists have attempted to associate personality with body build, assigning to the linear type such qualities as idealism, egoism, fastidiousness, moodiness and cynicism; to the lateral type, talkativeness, good humor, and plodding perseverance.

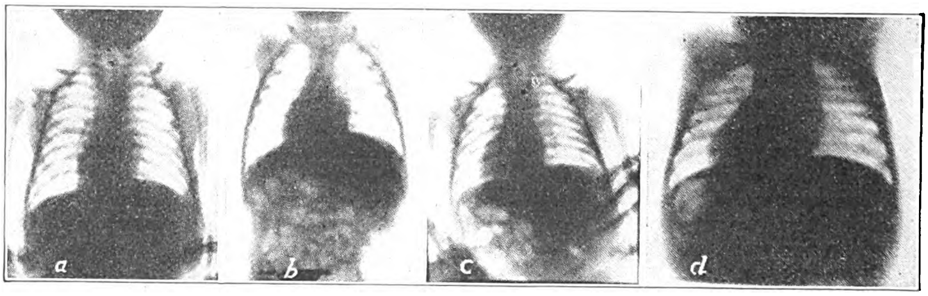
The Drs. Bakwin were able to classify infants by this method in their nutrition. They found, moreover, that babies suffering with malnutrition tend to be of the linear type, whereas those with eczema were of the lateral type. Obviously, therefore, the type of body build of the infant must be taken into consideration in determining whether or not it is maintaining a proper weight. Because of the body build, one tends to gravitate into certain types of occupation. All of these factors are taken into consideration by the modern scientific investigator.

Damages for Cockroaches

THE British courts have awarded 481 pounds damages to a woman on the ground that the encouragement of cockroaches by neighbors on a lower floor and the consequent invasion of her premises by numbers of these insects had produced in her insomnia and nervousness, damaged her rooms and her curtains, and caused her considerable work in an attempt at extermination. Her claim included 110 pounds special damages for repairs, materials, cleaning, and medical attendance.

Her medical attendant asserted that she had been bitten by the cockroaches, and that as a result she had a severe dermatitis. However, an expert witness for the defense asserted that the cockroaches would not bite. The cockroaches were a species known as *Blatta orientalis*, which do not bite or pierce the human skin, but which eat bedbugs. Both the cockroach and the bedbug appeared in England in 1583. Both are practically omnivorous, and not only eat organic refuse of all types but also each other.

(*Please turn to page* 85)



Variations in shape of chest and heart in infants, as applies to the discussion entitled "Body Builds of Infants," appearing in the center column above. The plate on the left, *a*, shows a long narrow chest scarcely wider below than above, the diaphragm sloping sharply downward toward the periphery. The heart is elongated and thin and almost vertically placed. The chest shown in the plate at the extreme right, *d*, is a marked contrast to *a*. The chest is short and broad and flares markedly below. The ribs, as well as the diaphragm, are almost transverse. The long axis of the heart is almost horizontal. Chests shown at *b* and *c* are of other intermediate types

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Case Hardening Steel by Nitrogen Treatment

THE fact that nitrogen embrittles iron and steel is not contested, and as brittleness is but a manifestation of hardness it is not surprising to find that many attempts have been made to employ nitrogen as a hardening medium for iron and steel. It may be that in cementing and case-hardening iron with cyanides, the nitrogen plays its part with the carbon, according to a writer in *Chemical Age*. Case-hardening by nitrogen has been the subject of numerous experiments, and renewed interest has been taken in the subject since it has formed the basis of several patents recently applied for by the Krupps. The patent specifications are not very explicit, but from time to time the Krupp experiments with nitrogen have been described in the German technical papers, and the broad outlines are fairly well-known. Most of the work has been carried out by A. Fry.

The process is more particularly applicable to the case-hardening of small steel parts which it is desirable to preserve carefully from all distortion. The process is carried out, therefore, at the comparatively low temperature of 580 degrees, Centigrade, and the case-hardening and nitrogen-yielding medium employed is a gas consisting chiefly of ammonia. Heating is continued for a considerable time (40 to 60 hours) but, while the case is satisfactorily hard, it is said not to be brittle, as the temperature is below that at which the noxious nitrides (Fe_2N and Fe_4N) form. The equally noxious iron nitride eutectoid (Braunite) with which, according to Fry, the objectionable brittleness is chiefly associated, is not found in the finished and case-hardened article. The case is glass-hard and greyish in appearance when the articles are withdrawn from the furnace, but it is easily polished and retains a high surface finish. The process is applicable to parts which it would be difficult or impossible to carburise in the ordinary way.

Germany's Chemical Industry Expands

THE policy of consolidation and expansion which has characterized the operations of German chemical producers during recent years was continued in 1928, a survey of the German chemical industry just issued by the Commerce Department reveals.

During the past year, according to the survey, the German Dye Trust, representing approximately one third of German chemical production, concluded agreements with British, French, Swiss, and Italian chemical firms and acquired a half interest in a large American photo-chemical plant. In addition it officially ratified the Franco-German dye pact of 1927. In February of the current year it increased its holdings in a Swiss company by 50,000,000 dollars, a move believed to be the forerunner of further foreign investments. The most likely prospects mentioned in this connection include a Swiss dye company, and Dutch and French rayon firms. All of these interests, it is pointed out, have affiliations in the United States.

By means of international cartel agreements, the German chemical industry has partially regained its former dominance in the world's dye markets. It holds first place in production of synthetic nitrogen fertilizers, producing last year about one half of the world's supply, and shares with France what amounts to a virtual monopoly of the world's potash market. In 1928 nearly a third of Germany's billion dollar output of chemicals went into export trade.

Notwithstanding the fact that Germany is the world's second largest producer of chemicals, its imports of both raw and finished materials in this line have increased markedly. American benzene, turpentine, rosin, sulfur, and phosphate rock enjoy large sales in the German market and appreciable quantities of American sulfur dyes, pyroxylin lacquers, and toilet preparations were also shipped to Germany in 1928. Approximately one eighth of Germany's chemical imports originated in the United States.

Proposes Power from Polar Cold

REGIONS of intense heat, such as the great tropical deserts, have often been proposed as sources of natural power. It has remained for H. Barjot, a Frenchman, to visualize the polar wastes in the same rôle. After all, our conception of "hot" and "cold" are purely relative, and while it would be rash to predict immediate commercial application of the idea, no doubt it is scientifically plausible.

M. Barjot suggests that the water at almost zero degrees beneath thick layers of ice in regions where the air temperature is of the order of 40 degrees might be pumped to the surface and the latent heat (liberated by the water in freezing) used to boil a liquefied gas such as ammonia or, preferably, to remove by boiling a volatile non-aqueous hydrocarbon such as propane from an intimate mixture with water. The fluid could then be used to work a turbine, frozen sea-water or brine providing an efficient and convenient condenser, since the hydrocarbon would be recoverable from the saline liquor produced by fusion. If the mechanical efficiency of the installation is assumed to be four percent, one cubic yard of water would supply energy equal to that produced by the fall of the same quantity of water through 4000 feet.

Mysterious Superiority of "Leviathan's" Steel Plates a Myth

ANOTHER myth in which mysterious superiority was attributed to a product of the skill of German chemists was exploded recently when exhaustive laboratory tests at the United States Bureau of Standards established the fact that the steel plates of the great German-built liner, *Leviathan*, resist saltwater corrosion no better than any other good ship-plate. The statement has frequently been made that the steel plates used in the construction of the hull of the *Leviathan* have shown in service a marked superiority in resistance to corrosion by sea water to that shown by other ship plate.

Several years ago the results of comparative tests of some of the original steel plates from the *Leviathan* hull and some steel-plate attachments to the hull, added at the time the ship was used for transport duty in the World War, were reported to show the striking superiority of the former. The importance which has been attached to the reports of the outstanding superior quality of the *Leviathan* ship-plate with respect to corrosion resistance is attested by the fact that within the past two years a large American oil-refining company specified that ship-plate similar to that used for the hull of the *Leviathan* should be used.

A series of corrosion tests of mild steels, including some *Leviathan* and other ship-plate, was made by the wet-and-dry and the continuous-immersion methods in sea-salt solutions. The steels varied in copper content from a trace to over 0.60 percent. No differences in corrosion behavior were observed other than those resulting from difference in the test methods employed. The corrosion rate in the wet-and-dry test decreased as the surface film was built up but was always much higher than that for simple immersion.

The laboratory test results have not confirmed in any way whatsoever the claims made for the *Leviathan* plate for unusual superior corrosion resistance. It is believed that differences in the service conditions, the importance of which has apparently not been fully appreciated, will account satisfactorily for the alleged difference in the corrosion behavior of these steels.

Columbium May Come Out of the Museum

AMONG the so-called rarer metals, columbium has as yet found little or no industrial application, although tantalum, with which it is practically always associated in nature, plays an important rôle in the manufacture of dental and surgical instruments, pens, crucibles, electrodes, and electrolytic rectifiers. Tantalum alloys readily with many other metals such as iron, aluminum, molybdenum, titanium, and tungsten. The importance of these alloys lies in their high melting point and great hardness.

Although the properties of columbium resemble very closely those of tantalum, it has received comparatively little attention. Perhaps a partial reason for this has been due to the difficulties involved in the methods available for the extraction of columbium.

A recent investigation of "The Determination of Tantalum and Columbium" conducted at the Rare and Precious Metals Experiment Station of the United States Bureau of Mines, Department of Commerce, in co-operation with the University of Nevada, at Reno, Nevada, makes use of an entirely new method for the separation of these two elements. It possesses an advantage both in time and expense over the older methods of obtaining columbium free from tantalum. Should this method prove satisfactory for the separation of large quantitites of these elements, it should result not only in a cheaper production of tantalum but in the stimulation of interest in columbium and should bring into use one more of the rarer metals, whose properties have been so beneficial to the manufacturing industries.

Sunflower Seeds Supply Russia with Potash

EVERYONE knows that Russia is a tremendous country with rich resources as yet undeveloped; but it will surprise many to know that one of that country's important raw materials is sunflower seeds. Russia is producing 3000 tons annually of carbonate of potash from dried sunflower seeds, according to C. H. MacDowell, President of the Armour Fertilizer Works. That production, although only a drop in the bucket as far as the world supply of potash is concerned, represents "considerable" sunflowers.

World production of potash is steadily increasing, having amounted to 1,600,000 tons in 1927. The United States produced more than 50,000 tons in 1928, which was only one sixth of the total consumption of this essential fertilizer in this country.

Titanium Pigments Invade the Paint Field

ALTHOUGH titanium is far from being the "rare element" many seem to think it to be (it far exceeds in abundance in the earth's crust the "common" metals copper, zinc, lead, tin, and manganese), there are comparatively few uses for it, say A. W. Hixon and W. W. Plechner, writing in a recent issue of *Chemical and Metallurgical Engineering.* Although widely disseminated, the important commercial deposits are more or less localized in Virginia and Florida in the United States, Quebec Province in Canada, in Norway, the east coast of Africa and at Travancore, India.

More recent, and of rapidly increasing importance, is the use of titanium oxide pigments. This development is largely a result of the more exacting requirements of white pigments, induced by competition between the manufacturers of those generally used, that is, white lead, zinc oxide, and lithopone.

Desirable properties in any white pigment are: whiteness; chemical inertness; hiding power; a degree of subdivision which is amenable to control; ability to form with a vehicle mixtures which do not require a large amount of the vehicle merely for the purpose of wetting the pigment; when dried in a thin film that film should be as permanent as possible; on disintegration of the paint film a surface suitable for repainting should be left. Titanium dioxide, alone or combined with inert fillers, possesses these properties to a marked degree.

Paints made with titanium pigments have shown no tendency to crack or peel, but have worn down evenly and uniformly, the surface finally becoming powdery ("chalking") and remaining in excellent condition for repainting. Since a pure titanium oxide paint is inclined to be too elastic, the addition of zinc oxide as a hardener gives an even more durable paint. Owing to the fact that titanium oxide is a neutral pigment it has no action whatsoever on the vehicle, making a very slow-drying "tacky" paint. This condition is overcome by the addition of zinc oxide or driers.

Since titanium oxide, like the similar oxide of silicon, is the most stable compound of the metal, the pigment is extremely resistant to attack by any of the destructive agencies to which it is likely to be exposed. That it will resist the attack of sulfuric acid, which is notoriously the chief destructive agent in the air of cities, that it is not liable to discoloration by hydrogen sulfide and that it is fully oxidized and therefore is not attacked by sea air or salt water, make it an excellent pigment.

The physical properties of this material further enhance its value as a pigment. Its opacity is greater than that of any other known white pigment.

Corrosion-Resistant Metals Not Immune To Electrolytic Corrosion

THE electro-chemical relation of metals to each other is utilized to protect metals from corrosion. Tin alone would make excellent "tin" cans were it not for its cost and softness. Therefore, it is plated upon an iron base, and as a rule it protects the iron from corrosion brought about by the contents of the can. At a recent Canners' Convention, E. F. Kohman reported that he had made cans from so-called stainless steels, such as chrome steels, chrome-nickel steels, and copper-nickel steels, and that all possessed excellent corrosion resistance when filled with foods which ordinarily give trouble in tin cans. Yet when such cans made from corrosion-resistant alloys were given a tin coating, the cans corroded readily—much more rapidly than ordinary tin cans.

This striking failure of a combination of metals which individually resist corrosion is caused by the electrolytic action which occurs when dissimilar metals are immersed together in a liquid which may serve as an electrolyte.

New Paving Uses Steel Framework

A NEW street paving material, patented in Great Britain and soon to be tried out in Paris, is known as Surfastal and is laid as follows: A concrete foundation about six inches in thickness is first built, upon which is poured a 0.5 inch layer of asphalt. A steel trellis or framework is then placed upon the asphalt, composed of strips one inch in height, 0.125 inch in thickness, and forming squares of about five inches on the side. To prevent displacing before completion of the surface, each square is connected by steel pins.

When this trellis has been set in place, the squares are filled with asphalt and the resulting surface is thus divided into a series of small squares, bounded on each side by strips of steel, connected by steel pins. Since the framework is sufficiently flexible to conform to the profile of the foundation, it becomes an integral part of the wearing surface. The weight of heavy loads, therefore, is supported by the steel framework distributed over a considerable surface area, and the wear on the aphalt is never more than the wear on the edge of the steel strips, thus reducing maintenance cost to a minimum.

When asphalt or concrete is used in the surface layer, the material contained in each square extends under the steel framework to the contiguous squares and forms a homogeneous mass, separated on the surface only by the steel strips to a depth of one inch.

Furfural Becomes a Staple Commodity

THE production of furfural by scientists in the United States Department of Agriculture at Washington is cited by the Institute for Government Research, in a recent monograph on the Bureau of Chemistry and Soils, as an example of how the agricultural chemists have converted various farm wastes into useful articles of commerce. Furfural is made from oat hulls and corn cobs, and is widely used as a solvent.

Although farm wastes contain pentosans, and pentosans may be converted to furfural by a simple acid distillation, the institute points out that the government's chemists were the first to produce furfural on an important commercial scale.

"The present American output of furfural," the Institute's publication says, "is more than a half million pounds, with an average selling price of 10 to 17 cents a pound. Before 1922, when the color laboratory of the Bureau of Chemistry and Soils started work on the production of furfural, it was a chemical curiosity valued at 30 dollars a pound.

Sulfur Dioxide Health Hazard Exaggerated

THE increasing use of liquid sulfur dioxide in small refrigeration units has caused considerable attention to be given to its effects on people who might breathe it. Apparently no really serious scientific study along these lines has yet been made, says *Chemical Markets.* References in medical literature are probably to tests using gases such as exist around smelters, which may contain, besides sulfur dioxide, other chemicals.

Several, if not all, medical references to the subject carry the same statement that "On the membranes of the nose and throat sulfur dioxide forms sulfuric acid." If sulfuric acid is formed, it is formed only to an extremely small extent. No such modifying statement appears, so that it can readily be seen how badly misled anyone may be who is interested in trying to learn what to expect when he, or his friend, or client, has breathed sulfur dioxide.

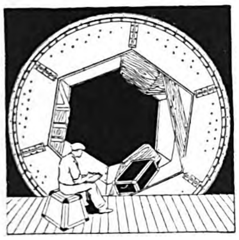
Everyone can picture all too vividly what sulfuric acid would do to the membranes of the nose and throat, but few can be expected to know that, if formed at all from sulfur dioxide, this sulfuric acid is formed to an extremely small extent, and hence that any injury from sulfuric acid so formed is almost impossible. It seems quite probable that these references in the medical literature were intended to read "sulfurous acid" and not sulfuric acid. Sulfurous acid (H_2SO_3) is sulfur dioxide in water. Its properties are decidedly different from sulfuric acid.

One other point on what has been written about the effects of sulfur dioxide, and that is, while the data given show serious effects or even death after breathing gases containing certain volumes of sulfur dioxide,

(*Please turn to page 87*)

How this *grainless* wood started a box maker in the toy business

Here are the facts about a box maker who improved one product, developed another and cut material waste to 2% by adopting Masonite Presdwood. In scores of other industries this grainless wood has proved equally profitable. Perhaps you, too, can employ it to advantage. Samples for test gladly supplied.



THE LEWIS TEST DRUM

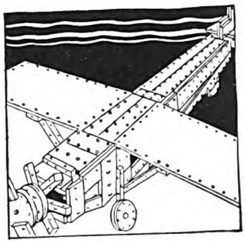
Striking sharp steel projections in the revolving test drum, dropped 4,193 times before it broke, a Masonite Presdwood box, with light sheet metal covering, proved itself vastly superior to a similar box of all-steel construction. The test resulted in the adoption of this grainless wood by the G. B. Lewis Company of Watertown, Wisconsin, for use in its Multitrip Boxes. Then it was found that the scraps from the box factory were ideal for toys.

No cross grain in Presdwood

These smaller pieces of Masonite Presdwood were really scraps in size alone. Toys of this grainless material are ideal for small children because of freedom from splinters. Resistance to warping insured durability for toys that might be left out of doors. The naturally attractive appearance of Presdwood was recognized as a sales asset not to be passed by lightly.

Thus is explained the appearance of Arkitoy construction sets in the toy shops and department stores last Christmas.

But Presdwood does much more than build strong boxes and light toys. It panels ceilings of railroad coaches and the salons of steamers. It serves in hulls and decks of fast hydroplanes and makes sturdy side panels for motor trucks.



FOR MAKING ARKITOYS

Where outdoor signs are made in quantities you will find it ordered by the carload because of its ability to stand the weather and take any paint finish.

It panels walls and ceilings of fine homes and adds an air of distinction to corridors and offices of stately buildings. It builds strong partitions and light shelving; lines closets and elevator shafts. Where builders want a specially fine surface on the outside of a building they use Presdwood to line the concrete forms.

Production managers like to use it in the factory. Home mechanics find it handy to have for odd jobs around the house.

Never harms fine tools

This easily worked material never harms good tools for it is made entirely of wood—contains no artificial binder. It comes in 4-foot by 12-foot boards, either 1/8 inch or 3/16 inch thick. It can be punched, die-cut, milled or sawed.

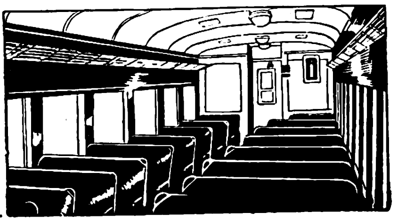
Builders, factory executives and home owners should send for the booklet which tells the fascinating story of Presdwood and beautifully illustrates many of its uses.

MASONITE CORPORATION
Dept. 739, 111 West Washington Street
Chicago, Illinois

FOR STEAMBOAT PANELING

Masonite PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR CEILINGS OF RAILWAY COACHES



© 1929 M. F. Co.

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

AIRPORT ILLUMINATION explains the lighting requisites for landing fields and routes. Numerous photographs and diagrams show examples of proper illumination under a wide variety of situations. The design and illumination of air marking signs is also discussed, with recommendations for an adaptable scheme of lighting. *General Electric Company, Schenectady, New York.—Gratis.*

Commerce

A REVIEW OF RAILWAY OPERATIONS IN 1928, by Julius H. Parmelee, discusses the significant traffic trends during the year, particularly the sharp upturn in freight traffic during the fall months after a half year of rather discouraging deficiency in carloadings. The present satisfactory state of the railroads is credited to their program for improvement. *Bureau of Railway Economics, Transportation Building, Washington, D. C.—Gratis.*

THE TRADE AND RAILWAY OUTLOOK, by R. Bell, reviews recent railway events and tendencies in Great Britain, America, Germany, and elsewhere in an interesting and stimulating manner. *London and North Eastern Railway Works, Stratford, England.—Gratis.*

INTERNATIONAL TRADE IN FURS, by Thomas J. Biggins, deals with the production of furs in the United States, and domestic and foreign trade in skins and furs. *United States Government Printing Office, Washington, D. C.—10 cents.*

FRENCH AND GERMAN INLAND WATERWAYS, Trade Information Bulletin No. 597, reviews the growth of the French and German waterway systems, with numerous comparisons. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

RADIO MARKETS OF THE WORLD, Trade Information Bulletin Number 600, deals with conditions which affect radio broadcasting and reception in different parts of the world, and discusses the markets for radio apparatus and the regulations governing its use in various countries. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

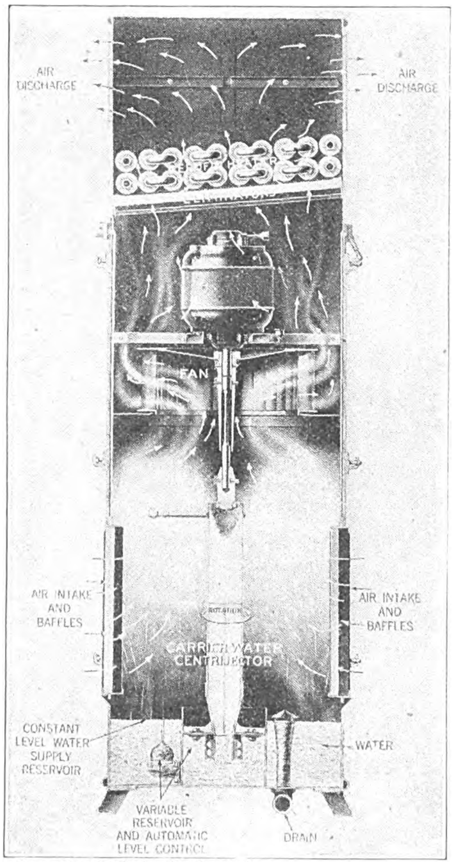
Education

A BIBLIOGRAPHY OF GEOGRAPHICAL LITERATURE FOR ELEMENTARY GRADES AND JUNIOR HIGH SCHOOL, by Ella B. Knight, is a well-indexed bibliography of the literature of geography. It is designed to acquaint classroom teachers with the nature and sources of a wide variety of supplementary instructional material for geography classes. *Department of Geography, Clark University, Worcester, Mass.—25 cents.*

ANNUAL REVIEW OF LEGAL EDUCATION contains an up-to-date list of law schools in the United States and Canada, with data about their courses, tuition fees, and student attendance. Another valuable list presents pertinent data regarding bar admittance requirements for each state and province. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

Industry

MANUFACTURED WEATHER IN THE PRINTING AND LITHOGRAPHING INDUSTRIES shows how troublesome variations in temperature and humidity can be removed from a plant by means of proper air conditioning equipment. *Carrier Engineering Corporation, Newark, N. J.—Gratis.*


AIR DISCHARGE
AIR DISCHARGE
FAN
AIR INTAKE AND BAFFLES
AIR INTAKE AND BAFFLES
CARRIER WATER CENTRIJECTOR
CONSTANT LEVEL WATER SUPPLY RESERVOIR
WATER
VARIABLE RESERVOIR AND AUTOMATIC LEVEL CONTROL
DRAIN

Courtesy Carrier Engineering Corporation

Phantom view of a unit air conditioner, showing how the air is cleaned, given proper temperature and humidity, and then circulated

RAYON—A NEW INFLUENCE IN THE TEXTILE INDUSTRY is a well prepared booklet of information and statistical tables showing the development of the rayon industry and the market for rayon products in the United States. *Policyholders' Service Bureau, Metropolitan Life Insurance Company, 1 Madison Avenue, New York City.—Gratis.*

SIMPLIFIED PRACTICE, WHAT IT IS AND WHAT IT OFFERS, is a summary of the activities of the Division of Simplified Practice of the Department of Commerce. A detailed description is given regarding the services offered to various American industries. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

THE MANIT SYSTEM contains information regarding the standard man-minute of work, by which many organizations have been able to save an average of 21 percent on their payrolls while increasing wages to employees by an average of 17 percent. *Haynes Corporation, First National Bank Building, Chicago, Illinois.—Gratis.*

POWER PLANT INSTRUMENT DATA BOOK provides information from which a suitable plan of instrument equipment may be easily worked out for any steam plant. The applications cited are presented from the viewpoint of operation, for measuring temperatures, pressures, flows, liquid levels, percentage of carbon dioxide, and speeds. *Brown Instrument Company, Philadelphia, Pa.—Gratis.*

Mining

TEN DECISIONS ON IMPORTANT MINE SAFETY PROBLEMS, Information Circular 6091, supplements the handbook "Safety in Coal Mining," published by the Bureau of Mines some time ago. The decisions were made by the Mine Safety Board to define the Bureau's collective opinion as to safety practices, safety devices, or safety methods for underground and open-pit mining. *Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

LIST OF PERMISSIBLE MINING EQUIPMENT, Bureau of Mines Information Circular 6097, includes equipment for mines that has been tested and approved with special reference to safety features. The system under which the devices are tested permits the manufacturer, whose product conforms to minimum requirements for safety in use, to mark his equipment with a seal showing that it has been approved by the Bureau. *Department of Commerce, Washington, D. C.—Gratis.*

MUDITING TO PREVENT EXPLOSIONS IN COAL MINES, Information Circular 6099, contains the results of an investigation of the Bureau of Mines. The circular shows that while muditing is probably more dependable than watering, especially in haulage-ways which also act as intake air ways, it is probable that adequate rock-dusting methods would be more dependable and less pensive. *Bureau of Mines, Department of ommerce, Washington, D. C.—Gratis.*

Research

DIRECTORY OF RESEARCH ON HEAT RANSMISSION IN THE EDUCATIONAL INSTITUTIONS OF THE UNITED STATES is a ompilation that will be of interest to all oncerned with heat transmission. It is a ood example of the plan of correlation and ppraisal of various research activities that s being followed by the National Research Council in several industrial fields. *Comnittee on Heat Transmission, 40 West 40th Street, New York City.—Gratis.*

HIGH-PRESSURE GAS-COMPRESSION SYSTEM, Circular No. 61 of the United States Department of Agriculture, describes and llustrates how to make an apparatus for esearch work with gases at normal temperatures and at pressures up to 1500 tmospheres, or about 22,500 pounds per square inch. Detailed drawings of each piece of equipment are shown, and approximate costs are included with the description of the apparatus. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

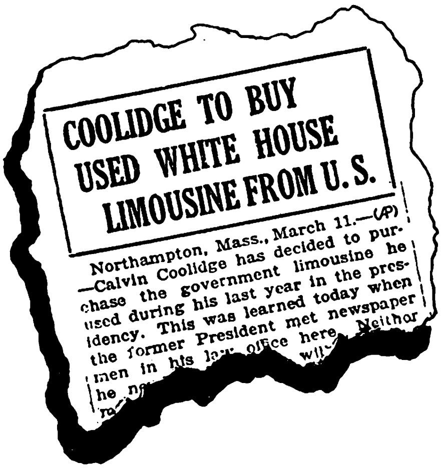
Miscellaneous

OPPORTUNITIES FOR CHEMISTS IN THE UNITED STATES CIVIL SERVICE shows that the government employs more chemists than any other organization in the world. Full and complete information is given regarding salaries, requirements, examinations, and the various governmental agencies in which chemistry plays an important role. *United States Civil Service Commission, Washington, D. C.—Gratis.*

KEY-CATALOG OF INSECTS OF IMPORTANCE IN PUBLIC HEALTH, United States Public Health Service Hygienic Laboratory Bulletin No. 150, is a condensed, systematized compilation of the data of entomology as they apply to public health. About a thousand entries are alphabetically arranged and cross indexed with brief notes under such headings as parasites, pests, and biting, poisonous, and stinging insects. *U. S. Government Printing Office, Washington, D. C.—20 cents.*

THE KICKING HORSE TRAIL, one of several handsome little booklets designed to lure the motorist to the Canadian Rockies, describes the scenic highway from Lake Louise, Alberta, to Golden, British Columbia. For those who have the wherewith and the withal for a vacation to be remembered forever, this booklet will solve the problem. But if you go to the northwest for a vacation, don't overlook the Waterton Lakes country, and our own Glacier National Park. *The Department of the Interior, Ottawa, Canada.—Gratis.*

THE CONTROL OF FLOODS BY RESERVOIRS, BULLETIN 14, by Paul Bailey, is a 463-page appendix to the summary report to the Legislature of 1927 on the water resources of California and a co-ordinated plan for their development. The entire volume is given over to an analysis of the possibility of co-ordinating programs of flood control and conservation. *Department of Public Works, State of California, Sacramento, California.—Gratis.*


COOLIDGE TO BUY USED WHITE HOUSE LIMOUSINE FROM U.S.

Northampton, Mass., March 11.—(AP)—Calvin Coolidge has decided to purchase the government limousine he used during his last year in the presidency. This was learned today when the former President met newspapermen in his la office here. Neither he n wil

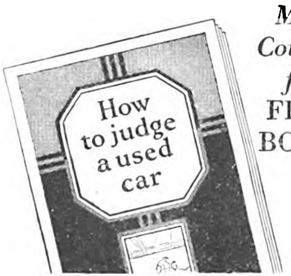
Don't let *false pride* keep you from enjoying a *better car*

EVERYONE rides in a "used" car for every car on the street is "used"! The newest model is a "used" car after you drive it around the block. A high quality six or eight, reconditioned and guaranteed by a Studebaker dealer, is a better buy and a better car than any cheaply built new one near its price.

Regardless of where you buy your car, or what make you prefer, send today for this valuable free book—"How to Judge a Used Car." It tells you frankly what to look for and what to avoid. Pictures and plain statements never before made public show you how experts buy cars for resale.

Send for Free Book

More than 145,000 people have been glad they spent 2c mailing a coupon—like the one below—to learn facts from this free book that saved them $200 or more on their motoring! Mail the coupon *now!*


How to judge a used car

Mail Coupon for FREE BOOK!

Pledge to the Public on Used Car Sales

1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.

3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

© 1928 The Studebaker Corporation of America

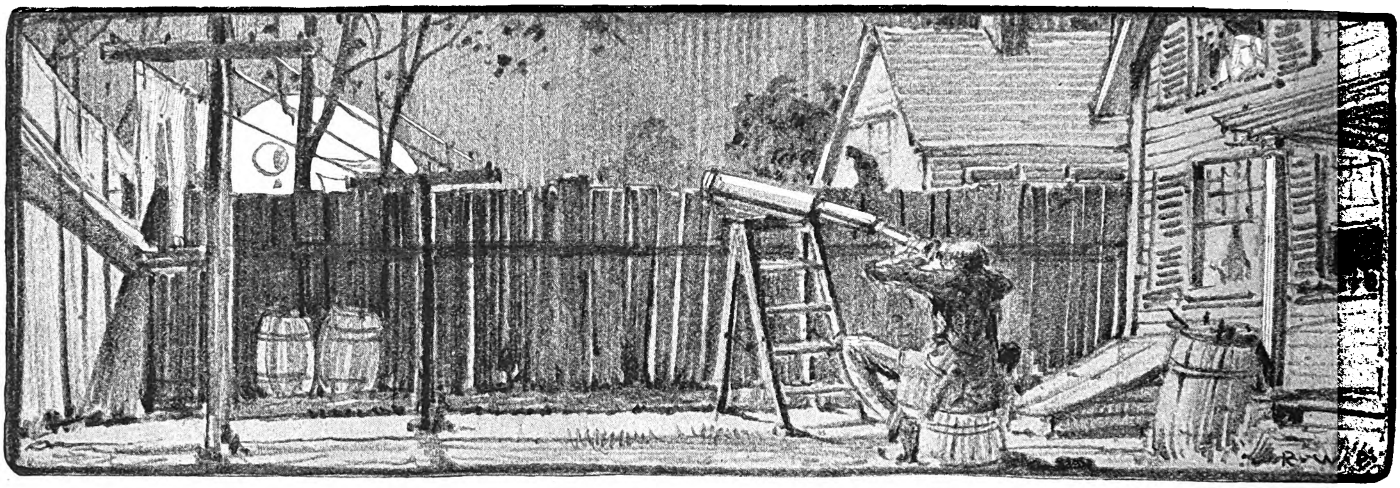
THE STUDEBAKER CORPORATION OF AMERICA
Dept. 257, South Bend, Indiana
Please send me copy of "How to Judge a Used Car"

Name..........

Street..........

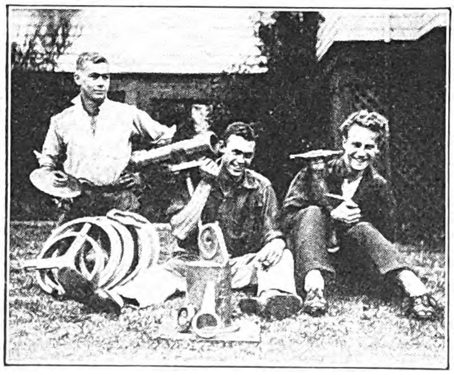
City.......... *State*..........

STUDEBAKER
Builder of Champions



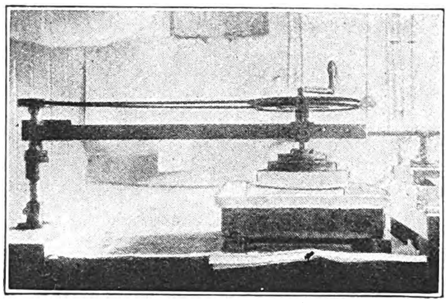
The Amateur Astronomer

As explained in Part V of the book "Amateur Telescope Making," which treats of automatic machines for those who prefer not to perform the customary hand work of making the concave mirror of a reflecting telescope, a machine is not a necessary adjunct to the telescope maker's shop; not one amateur out of a hundred uses one. Some, however, really enjoy designing and making a machine, and to such the illustrations reproduced in these columns may prove of interest.

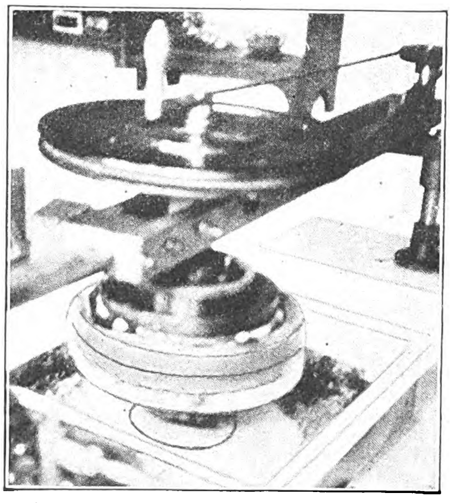


Moore and his two co-workers

F. Moore, 1021 Pemberton Road, Victoria, B. C., Canada, sends in three photographs, one showing two friends and himself with several interesting exhibits of machine work as added scenic features. Mr. Moore is rather short on words—all he writes is: "I enclose photos of a grinding machine I have constructed. On it an 11-inch speculum is being completed. The 2½-inch achromatic object glass for the finder and the lenses for the eyepieces were also made on it." Evidently Moore and his friends have been making something quite elaborate in the way of a telescope, short of a 200-inch. We hope they will some day favor us with a picture of the complete job.



Moore's grinding machine



Another view of Moore's machine

Mr. Frank G. Milligan, 715 Ravenna Road, Seattle, Washington, writes as follows: "Enclosed you will find photographs of a vertical grinding lathe I built for grinding and polishing my eyepiece lens and prisms. The main gear wheel is eight inches in diameter with 50 teeth, and there are two screw threads on the worm. The bearings are made of steam fittings. Three bearings are made of 1½ inch by ¾ inch pipe crosses. The main bearing for the vertical shaft is made of a 3 inch floor flange, with a close nipple sawed in half and screwed into the flange. In the nipple is set a small ball bearing embedded in babbit metal, and the end of the shaft is turned down to fit into the ball bearing. The upper end of the shaft is turned to a cone to fit the grinding flat. The vertical shaft is 8½ inches long, and the horizontal shaft carrying the screw is 12 inches long. Both shafts are made of one inch cold rolled shafting. I picked up the gear and worm in a second-hand machinery depot. The motor runs at 1750 r.p.m. The drive pulley is 2 inches, and the driven pulley is 4 inches, in diameter. The main gear makes 35 r.p.m. and reversing the pulleys gives 140 r.p.m. The vertical lathes used by opticians grinding eye-glass lens run 940 r.p.m.

Dr. K. Nakamura (see "A. T. M.," page 225, at bottom) of the Astronomical Observatory of the Kyoto Imperial University, Kyoto, Japan, writes: "The new edition of 'Amateur Telescope Making' reached me safely. I find the book is nearly completely perfected and now the best book of its kind. I feel interest to find my words on page 226. Since the August of 1926, there are thousands of mirror workers in Japan. Most of them were young students of 'teens age, which seems to be somewhat different compared with most American workers.

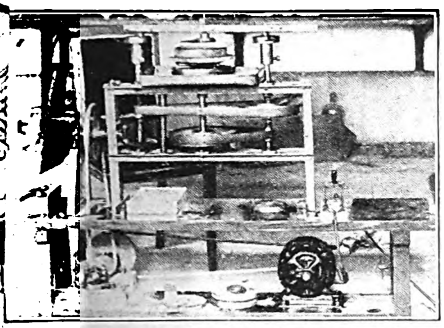
"I have enclosed a print of my grinding and polishing machine. The original design of this machine was by Mr. Hindle and appeared in *English Mechanics*, 1923. The machine is simple and easy to construct. It has some defect of producing hill at the center of the mirror, but nearly spherical surface is easily attained when the pitch condition is perfect. But the figuring must be done by hand. I am now working on my 130th mirror."

To this the editor replied, inquiring whether it might be thought advisable to advertise "A. T. M." in Japan. Some weeks later the following answer was received:

"Thank you for your kind letter. There is a book written about the mirror making by Mr. Yamasaki, published in 1926. I have written one recently which is expected to be published in next May. But some of the Japanese amateurs are requesting good foreign book. Therefore you can increase its sale. The Maruzien Company is the best and largest shop of foreign books.

"The Hindle's grinding and polishing machine is a good one but it still requires improvement. It is similar in principle to Ritchey's machine but is improved. My

Milligan's simple machine



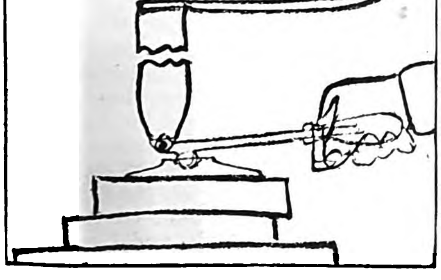
Dr. Nakamura's machine. A six-inch mirror can be completed, except the figuring, in seven hours

present one is one third dimension of original design. But I am now determined to make double sized one. I wish to add interchangeable straight stroke. I have recently polished several convex surfaces of object glass, with unexpected success. Although good surfaces depend on the best pitch, the interference test proved good spherical surface free from zones, without figuring.

"I start here for Sumatra on March 24 for the observation of total eclipse."

AMATEURS who like to experiment may try out the suggestion contained in Porter's sketch, which we reproduce, of a "dingbat" for applying pressure to a mirror during grinding. The Tel. Ed. first picked up the idea from watching a Chinese laundryman who was using a similar rig "for pressee hardee on shirtee." It consisted simply of a six foot vertical pole with a spring at the top attached to the ceiling, and a point at the bottom. This engaged with a depression in the flat-iron. The idea was sent to Porter who elaborated it as shown, saying he would try it out. Just then he was given a chance to try out something rather more important, as we all know, in California, and therefore it is hoped that someone else will try this stunt and report (1) whether it works, (2) whether it results in any net gain in time and temper.

IN addition to amateur telescope making there is another amateur hobby, at present undeveloped, which it is hoped may some day be taken up and if possible popularized in the SCIENTIFIC AMERICAN. That is, seismology. Several seismologists have expressed interest in the suggestion that amateurs be encouraged to construct inexpensive apparatus for recording earthquakes. In addition to genuine 'quakes there are other interesting local disturbances due to automobile traffic, blasting, railroads, vibrating factories, and so on. As Dr. T. A. Jaggar, volcanologist at the



Proposed "Chinee" grinding rig

THE PHILOSOPHY OF INDIVIDUAL LIFE

"Philosophy," from the Greek, "philo," meaning "loving, fond of, attached to" and "sophy" meaning wisdom. From this we may conclude "Philosophy" to mean being attached to, or fond of, Wisdom in the affairs of life.

No philosophy of life can appeal unless it is based on a scientific foundation. It must consist of logical principles built up on a basis of known facts. It must be founded on natural laws, each susceptible of proof.

Ethically considered, there are but two fundamental principles in Nature. In their relation to the Individual the one is constructive, or what we are accustomed to regard as "normal," and the other destructive, or what we are accustomed to regard as "abnormal." Every fact of Nature, whether scientific, philosophic or otherwise, aligns itself as a direct result of one or the other of these two fundamental principles in operation.

The problem of the Individual is that of identifying these two principles in their relation to the objective facts of life so that he may be able to conform to the one and avoid the other.

It may be conceded that the fundamental and essential elements of Individual responsibility are Self-Consciousness, Independent Choice, Reason and Independent Rational Volition. To these distinctive human possessions Science turns for the key which unlocks the door to Individual Accomplishment, for these are the inherent elements of human character.

According to THE PHILOSOPHY OF INDIVIDUAL LIFE, each Individual possesses, through proper use of these essentials, the power which enables him to adjust known scientific facts with natural law and thereby achieve greater understanding of life and living.

There is in Nature that which integrates physical matter and builds it up into individualized forms. It manifests itself to the objective senses in the integration and crystallization of stone. It is evidenced by the subtle force which integrates and binds together in solid mass the particles of various metals. It is observed in the condensation of vapors into liquids and of liquids into solids.

This integration and growth automatically responds to natural law in its manipulation of physical conditions. On the physical plane it takes hold of physical matter and integrates it, building it into Individual Form. On the intellectual plane it builds up Individual Intelligence. On the ethical plane it builds up Individual Moral Character.

As far as it has been possible to trace the authentic history of mankind, human Intelligence has intuitively sensed a great fundamental law underlying all these manifestations of Nature.

This fundamental law, back of the process which integrates inorganic matter and organizes vegetable and animal matter into living, organic bodies, constitutes the essential foundation of all natural development and growth in Individual Life.

What may be the ultimate goal, then, of Individual Achievement undertaken in accordance with known scientific facts harmonized with this fundamental law?

To answer this logically there has been prepared for the GREAT SCHOOL OF NATURAL SCIENCE a series of unabridged volumes. In these volumes the established facts of Science are correlated with natural law and applied to a sane and logical method of scientific Self-Development for the Individual Intelligence.

HARMONICS OF EVOLUTION: A statement of the Philosophy of Individual Life on the basis of Natural Science.

THE GREAT CRIME: The destructive principle in Nature.

THE GREAT WORK: The constructive principle in Nature.

THE GREAT KNOWN: Aspects of Natural Science relative to life under various conditions.

THE GREAT MESSAGE: The historic basis on which the Philosophy of Individual Life is founded.

SELF-UNFOLDMENT: Scientific principles of Nature and how they may be logically proven.

WHO ANSWERS: A brochure explaining methods by which results are obtained.

These volumes are distributed by the Pioneer Press, Dept. 512, Hollywood, California, on receipt of $12.50 full payment or $5 first payment. They may be kept and read five days before deciding whether or not you wish to own them. At the end of that time the volumes may be returned, upon which all money deposited will be immediately refunded in full, or if they are retained and a five dollar first deposit has been made, the balance of seven dollars and fifty cents should be forwarded.

Are you posted on Aviation?

YESTERDAY aviation was a fascinating game for the inventor, the manufacturer and the engineer, in which the public took but passing interest. Today, aviation is a great industry which affects every walk of life, every class of person, and every section of our country.

R. R. BENNETT

More than a billion dollars of investment money is being poured into the industry in America alone. Fortunes are being made and will continue to be made. Losses will be correspondingly great. Now, for the first time, an impartial critical analysis of aviation is available as a guide for the investor, the banker, the manufacturer, the merchant, and everyone else who wishes to know the real position of the new industry.

Just Published—

AVIATION

Its Commercial and Financial Aspects

by Richard Rea Bennett

This new book supplies an authoritative, unbiased analysis of the financial and commercial status of aviation and the indications of future trends which concern the investor, banker, manufacturer, and all others interested in aviation. The various phases of this new industry are surveyed to reveal both its features of strength and its weaknesses. Whether you are interested in aviation as an investor or as an active participant in the industry you will find the information supplied by this book helpful in avoiding pitfalls and in taking advantage of current opportunities for profit
130 pages, 4 illustrations............ **$3.00**

Other Important Aeronautic Publications:

INTERNATIONAL AIRPORTS

by Stedman S. Hanks

Lt. Colonel, Air Corps Reserve

Up to the present, Europe has led the world in air passenger traffic. The current rapid development of American air traffic makes the information on the best European practice supplied by this new book particularly important to American investors, airport officials, to executives of air transport companies, and to all others interested in the business side of aviation. Colonel Hanks discusses opportunities for increased profit in American airport operation in the light of what is being done abroad. He describes in detail the leading European airports covering location, area, layout, operation, management, financing, etc., etc., 195 pages, 46 llustrations...... **$5.00**

ELEMENTS OF AVIATION

by Colonel V. E. Clark

formerly Chief Aeronautical Engineer, U. S. Army

Explains on the basis of a few fundamental laws of physics, everything that can happen to an airplane in flight as regards stability and control. Will give anyone a clear understanding of why an airplane flies; why it is stable or unstable, controllable or uncontrollable, in various attitudes and conditions. 193 pages, 24 illustrations........ **$3.00**

(Fill in, tear out, and mail)

SENT FOR 5 DAYS' FREE EXAMINATION

The Ronald Press Company,
Dept. M158, 15 E. 26th St., New York

Send me, postpaid, the book (or books) checked below. Within five days after I receive it, I will either return it or send you my remittance in payment

☐ *Bennett*, **Aviation**.................. $3.00
☐ *Hanks*, **International Airports**.......5.00
☐ *Clark*, **Elements of Aviation**..........3.00

Name..
(Please print to insure correct delivery)
Home Address..
City........................State*............
☐ Employed by.
☐ or Reference..
*Orders from outside continental U. S. or Canada, cash plus 25 cents per book to cover shipping.

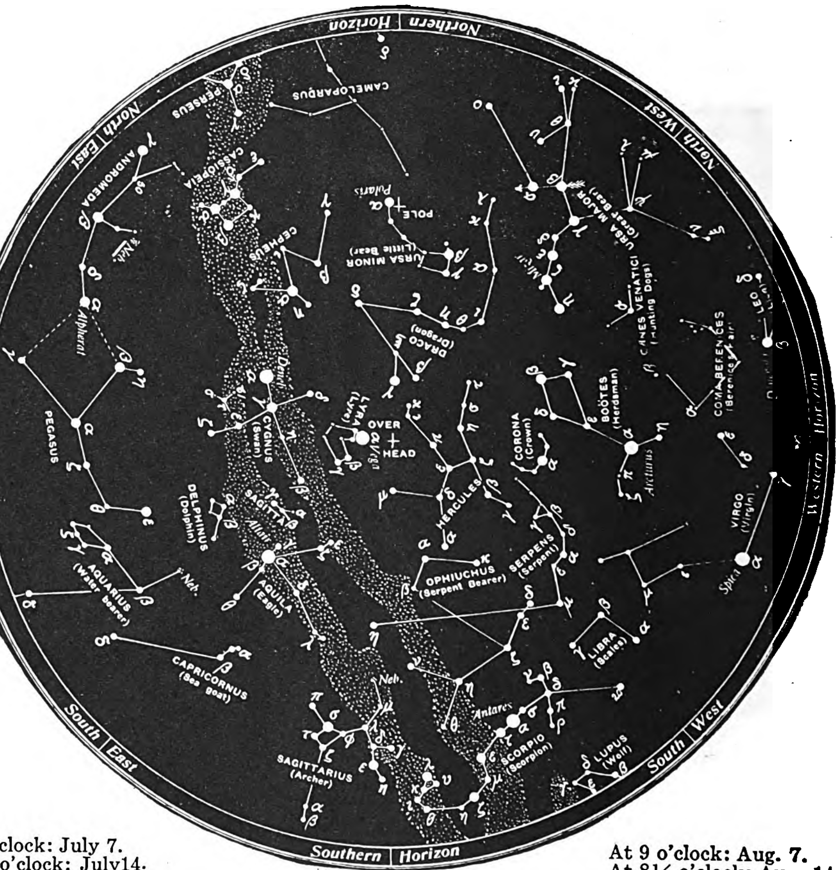
Hawaiian Volcano Observatory of the United States Geological Survey, states, "To record every car that passes, its weight and speed, would be quite possible with a seismograph. As to making an instrument for 50 dollars or less, that would be easy for a mechanic." A simple instrument has been described in one of the scientific journals.

At present there is no textbook on seismology suitable for the amateur, Hobbs' being rather old and Davison's being elusive in treatment. However, a noted seismologist is known to have a text book in preparation. Seismology as a hobby—in fact, any other hobby we know of which is suitable for readers of a scientific journal—could hardly compete with amateur telescope making; and the latter will not be dropped until there are signs that its hold is weakening—which certainly is not yet. Several have suggested that a special department of this journal be regularly devoted to all kinds of hobbies. This would possibly prove interesting, but where is the many-sided editor who is to run such a department, and where would the line be drawn? The number of hobbies is almost infinite.

How many readers of this journal would take an interest in amateur seismology and will write in to say so?—*A. G. I., Tel. Ed.*

The Heavens in July

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

MERCURY is a morning star, being at greatest elongation 21 degrees from the sun on the 3rd. Through the first half of the month he rises about 3:30 A.M. and should be easily visible. Then he closes in rapidly toward the sun and is in conjunction with him on the 31st. Venus is a morning star, rising about 2 A.M., and is very conspicuous. Mars is still in the evening sky and sets about 9:30 P.M., but he is no longer a prominent object. Jupiter is a morning star and is close to Venus. The planets are in conjunction on the 14th, and only 2 degrees apart. At this time they are in Taurus, only a few degrees from Aldebaran, and the three bright objects will form a very pretty picture. Saturn is in Sagittarius and comes to the meridian near 10 P.M., in the middle of the month. His rings are seen at their widest angle and, although so far south, he is a fascinating telescopic object. Uranus is in quadrature west of the sun on the 3rd, and is observable in the morning. Neptune is an evening star and is too near the sun to be easily observed.

The moon is new at 4 P.M. on the 6th; in her first quarter at 11 A.M. on the 13th; full at 2 P.M. on the 21st; and in her last quarter at 8 A.M. on the 29th. She is nearest the earth on the 6th, and farthest away on the 19th. During the month she is in conjunction with Venus on the 3rd, Jupiter on the 4th, Mercury on the 5th, Neptune on the 9th, Mars later on the same day, Saturn on the 18th, and Uranus on the 27th.—*Princeton University Observatory.*

The Month in Medical Science

(Continued from page 76)

There are a thousand different kinds of cockroaches, more or less. Four are domesticated and are happy around a home. They vary from the rather small reddish insect found in many American kitchens and basements to the German cockroach called the croton bug. This is the slipperiest, quickest, smartest, and meanest of the lot.

Cockroaches, like some human beings, do most of their wandering at night, soiling everything they touch and leaving a permanent nauseating odor. They migrate from one apartment to another, following water and drain pipes from cellar to roof, at least in apartments of moderate height.

Tularemia from the Muskrat

TULAREMIA, the infection first discovered in field mice and later in sick rabbits, then found to affect human beings, has now been found also in the muskrat. A physician of Montana has reported two cases in human beings resulting from skinning muskrats to obtain the pelts. It has not been definitely established just how the muskrat gets the disease, but undoubtedly its association with the rabbit and with other small animals is sufficient to explain the situation.

Reflex Itching in Asthma

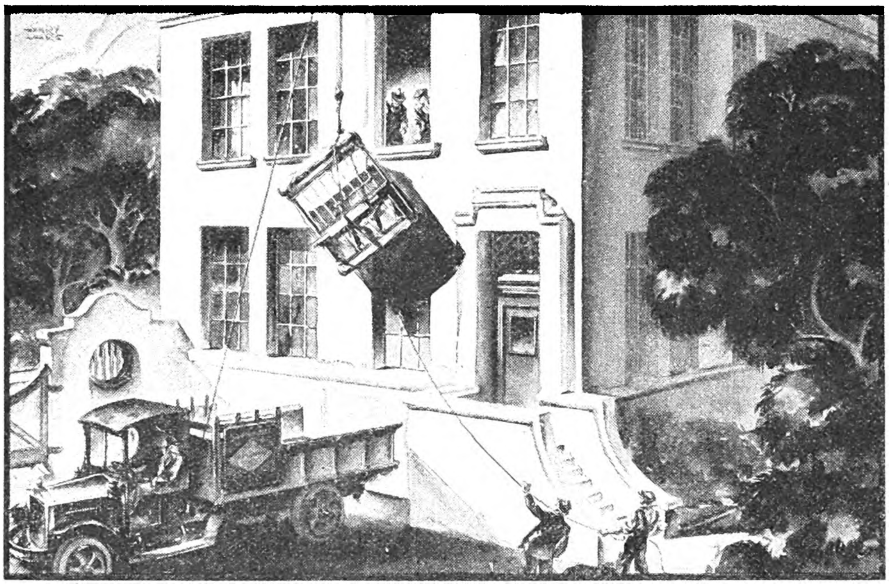
IT is not at all unusual for an asthmatic person to complain of intense itching of the eyes, nose, roof of the mouth, back of the throat, and even the ears. Recently Dr. R. M. Balyeat has found an associated itching of the skin of the patient in certain areas. In four cases of asthma which he studied with this point in view, the itching seemed to be the result of stimulation of the nerves of the skin, due to association of these nerve roots with those of the nerve roots coming from the lung. The symptom of itching of the skin of the chest was present in 13 out of 420 patients.

In one case, a woman was sensitive to chicken and goose feathers, to western water hemp, and to ragweed. The elimination of feathers from the home and desensitization against the weeds brought her relief not only of the asthma but also of the itching of the chest. Another woman with hay-fever and asthma was found to be sensitive to duck feathers, dog hair, cat hair, and the pollens of ragweed. The elimination of the substances to which she was sensitive, and desensitization, relieved her also of the itching, although some of the asthmatic symptoms still remained.

Apparently in such cases the itching is definitely associated with the sensitivity to various substances, and the relief of the disease itself serves equally well to relieve the itching.

Blindness Caused by Battery Fluid

BATTERY fluid is composed of sulfuric acid and water. Sulfuric acid is a caustic substance which may seriously injure any tissues with which it comes in contact. A report has recently been made available which indicates how dangerous such acid substances may be to the eye. In an automobile accident, a woman was pinned underneath an overturned coupé in such a manner that the fluid from the battery ran into both her eyes and into her



Thousands of improvements in central office equipment in 5 years

An Advertisement of the American Telephone and Telegraph Company

IN THE last five years there have been hundreds of improvements of major importance in telephone central office equipment in the Bell System, and lesser improvements by the thousands. Improvements have been made in switchboard cable, in relays, in cords, in condensers, in selectors, and in the development of new and better materials for all kinds of equipment used in the central offices.

These improvements have not only helped to meet the steadily increasing complexity of telephone requirements. They also make possible the high-speed service which is eliminating delay from the personal contacts of people anywhere in the United States, whether they be separated by three floors of a building or three thousand miles of country.

There is no standing still in the Bell System. Better and better telephone service at the lowest cost is the goal. Present improvements constantly going into effect are but the foundation for the greater service of the future.

WANTED TO MANUFACTURE

Articles which can be stamped from sheet metal for auto, hardware, or other trades. Advise fully.

THE OTTO KONIGSLOW MFG. COMPANY
3510 Perkins Ave., Cleveland, Ohio

WANTED PRODUCTION MAN

Thoroughly trained and educated man competent to take charge of highly technical small work. Must have management experience. J. H. W., Box 190—Scientific American.

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe

Standard of the World
Hand and Motor Operated
14 Sizes of Machines

What it costs to bend pipe our way, per bend:

1-inch pipe	5 cts
2-inch pipe	10cts
4-inch pipe	25 cts
6-inch pipe	60 cts
8-inch pipe	$1.00

Send for Catalogue

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

Why PURE CHEMICALS CORRECT ALL FEED WATER TROUBLE!

They prevent precipitation, control concentration, stop and prevent corrosion and pitting, remove oil or grease (carbonized or not), act uniformly under all temperatures and pressures, everything that is required to successfully treat boiler feed water. Only Pure *Corrective Chemicals* do this. *Pamphlet on Request*

UNISOL MANUFACTURING CO.
Jersey City, N. J., U. S. A.

Orders for UNISOL may also be purchased through HENRY W. PEABODY & CO., Export & Import Merchants, 17 State Street, New York City, N. Y., and their branch offices in Boston, San Francisco, London, Liverpool, Manila, Shanghai, Sydney, Melbourne, Auckland, Cape Town, Johannesburg, Durban, Buenos Aires.

Sime, Darby & Co., Limited, Singapore, S. S. Agents for Straits Settlements

250-POWER MICROSCOPE

The greatest value ever offered in a microscope—same type as used by Scientists, Physicians and Professional Physicists—a 250-power instrument with standard focusing arrangement. Ocular or lens at top of tube is double, removable and of high quality. Removable feature permits use of other standard ocular systems, giving many power ranges. Objectives mounted at bottom of tube, are of substantial triple construction and powers are approximately 65, 130 and 250. Laboratory type stand is fully adjustable so that instrument can be used for photographic work. Stage is extra large; equipped with clips for holding slides and objects. Just below stage is adjustable iris diaphragm so that light from mirror can be adjusted by touch of finger. Mirror is double, plain on one side and concave on reverse. Complete in handsome wooden case at the amazingly low price of $16.50. Save money . . . buy direct—money refunded if not absolutely satisfied after 5 day trial. Send check, money order or cash. Other equally amazing microscope values at prices up to $220 described in interesting folder—"Exploring Invisible Worlds." Write for your copy.

COMPLETE $\$16^{50}$

APPARATUS ENGINEERING CO.
Dept. A, 2006 Chestnut St.
Philadelphia, Pa.

ASTRONOMY
PHYSICS
CHEMISTRY

SCIENCE NEWS-LETTER

BIOLOGY
ANCIENT LIFE
PSYCHOLOGY

Delightful
Because it's Different

SCIENCE News-Letter is a weekly, purely scientific, yet brimful of human interest. It isn't technical, yet crammed with fact. Each article presents some new phase, slant, discovery or invention in science, investing it with ***the charm of a best-seller.*** On a warm summer evening you can enjoy Science News-Letter; while being entertained you have the added satisfaction of absorbing in condensed form, ***all the latest important news*** in every branch of science. This information is rushed to you within 2 weeks.

Sold to Libraries and individuals only

Introductory Offer,
$1 for 13 weeks

MEDICINE
HEALTH
HEREDITY

2143 B St.,
Washington, D.C.

ENGINEERING
RADIO
AVIATION

mouth and throat. By the time she was taken to the hospital, the eyes were so badly burned that it was impossible to do anything to save her eyesight.

The usual treatment for caustic burns of the eye involves thorough washing with sterile water, the application of olive oil or some bland oil, and the placing of ice cloths to the lids for four or five hours. Later, heat is substituted for the cold. Many authorities state that one drop of nitric or sulfuric acid is sufficient to destroy the eye.

The physician who reported the accident here mentioned suggests that mild solutions of baking soda might be preferable to ordinary water for washing the eye after an acid burn, since these would tend to counteract the effects of the acid.

The Slanting Eyes of the Chinese

IT has been the impression for years that the eye of the Mongolian is oblique. A recent investigation indicates that this is more apparent than real and that the opinion has been fostered by the traditional fondness of Mongolian artists and Caucasian actors for this style of countenance. Thus an actor who is making up as a Chinese exaggerates the impression of obliquity of the eye by painting an upward and outward extension of the eyebrows.

Dr. H. Gifford, after a study of 340 photographs of Chinese and Japanese and of 500 natives in Kioto and Yokohama, considers the notion of the special "mongolian eye" as much exaggerated. The most common and striking characteristic of the mongolian eye is some narrowness of the opening, combined with the result of a fulness and width of the space below the eyebrow and the margin of the fissure. A rudimentary eyelid, in the shape of a fold extending from the skin of the upper lid obliquely downward and inward to the bridge of the nose and persisting through life, seems to be much more common among Mongolians than other races.

Effects of Emotion on Digestion

FOR many years physicians have known that emotional states affect the secretion of the juices of the stomach and bowels and thereby digestion. Recently Dr. W. C. Alvarez has reviewed the available scientific literature on this subject in the light of cases that he has seen himself. More and more it is being realized that eating during times of strong emotion is not desirable and that appetite is dependent as much on mental factors as on physical. An old proverb has it that a dry morsel and quietness therewith is better than a houseful of feasting with strife.

Alvarez suggests that meals be postponed until strong emotions have passed, calm has been restored, fatigue lessened, and appetite returned. When a person is really interested in food, the stomach and intestines begin to secrete and the muscles begin to move things onward. When this motion does not regularly occur, attempts must be made to interest the patient in the food, and to give him things that are appetizing, and to allow him to smell, taste, and chew food.

For reverse action, such as occurs with heart burn, belching, hiccoughs, and similar forms of distress, it is suggested that these motions can be stopped and driven downward by swallowing rapidly, by sipping water, or by chewing gum.

The Study of
Criminology
is receiving more and more attention by students of sociology and betterment investigators.

❦

The standard work for one of the most interesting as well as one of the most intricate of the special lines is

The Fingerprint Instructor

By Frederick Kuhne

For many years the head of the Bureau of Criminal Identification of New York City.

Postpaid $3.15 domestic

❦

SCIENTIFIC AMERICAN

ASBESTOS
All grades of Crudes
and Fibres in large
or small quantities
Sold by
KEASBEY & MATTISON
COMPANY
Ambler, - Penna.
Branches in Principal Cities

Chemistry in Industry

(Continued from page 78)

no mention is made of the fact that as sulfur dioxide even in small quantities is so irritating, no one would breathe such a concentration unless they were so trapped they could not get away. Because a leak of sulfur dioxide makes itself so quickly and distinctly known, sulfur dioxide is often called a "safe gas." There is no chance, with sulfur dioxide, of one being killed as he sleeps, yet references in medical literature might so be construed by those who to-day, because of widespread use in small refrigeration machines, look up these references.

New Arc Light Carbons

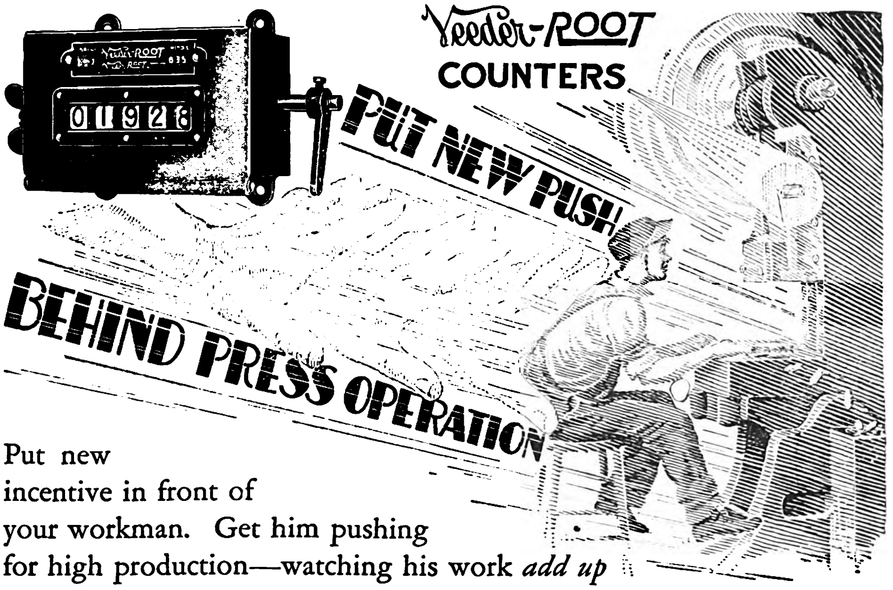
TO rival the sun has long been the objective of artificial illumination, but great as have been the strides made in electric lighting, the man-made light always lacks some of the qualities of Old Sol's output. A light that is hailed by a government bureau as "the closest approximation to natural sunshine" has recently made its appearance and it depends for its unique properties on the chemical treatment of the carbon pencils used to make the arc. The National Carbon Company is marketing this line of new ultra-violet ray lamps and carbons, which will be sold under the Eveready trademark. A new type of cored carbon has been developed, impregnated with rare earths and minerals. When burned electrically in pairs, the resulting light is said to have many of the valuable properties of sunlight.

Grading Cottonseed by Analysis

A NEW method of grading cottonseed by chemical analysis has been developed by G. S. Meloy, marketing specialist of the Bureau of Agricultural Economics. The old standard was based on the average value of seed as determined for various producing areas. As oil and protein content may vary as much as 25 to 50 percent and kernel content from 45 to 65 percent, need has been felt for a method applicable to separate consignments giving a price incentive to quality production. Oil is the most important factor in price determination. Since the ratio of oil in the kernel is in inverse proportion to that of protein, the problem would be fairly simple if extraction of perfect kernels were possible. Under present conditions, however, it is necessary to work with data obtained from a chemical analysis of the entire seed.

Expansion Effects in Concrete Explained

USEFUL as concrete is, in modern construction and industry, there are shortcomings which chemists now strive to eliminate. It is predicted that a better appreciation of the chemistry of concrete and special forms of cement will open entirely new fields of utility for this material. Thus, recent investigation has revealed among the reaction products formed by the action of sulfate waters on Portland cement, a calcium sulfoaluminate, thought by some investigators to be responsible for certain expansion effects sometimes observed in concrete. The exact nature of this compound, its condition of formation, and stability have been studied by the Portland Cement Association and the De-



Put new incentive in front of your workman. Get him pushing for high production—watching his work *add up* on a Veeder-Root Counter. Let him see his efforts COUNT in pieces per day or hour. So he'll be encouraged to do more, *earn* more—and you'll know you get all you pay for. Saving over-runs and under-runs by counting the work *as produced.*

The Veeder-Root Catalogue will show you Counters to register increased production at ANY machine. Sent free to all who may meet with the problem—in invention, engineering or manufacturing.

Veeder-Root INCORPORATED
HARTFORD, CONN.

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
STEEL LETTERS AND FIGURES
SCHWERDTLE
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN

MONEY
MYSTERY GAS LIGHTER
JUST OUT, LIGHTS GAS INSTANTLY WITHOUT SPARKS OR FLAME - SELLS LIKE WILDFIRE WHEREVER GAS IS USED —RETAILS FOR 25¢
MAKE $25 A DAY
SAMPLE FREE
PACKED ON INDIVIDUAL CARDS WITH INSTRUCTIONS
RUSH $10.00 FOR GROSS or 1.00 FOR DOZ.
NEW METHOD MFG. CO.
Desk SA-7 Bradford, Pa.
MONEY

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

partment of Commerce. This compound is formed by the interaction of sulfates with lime and aluminates. It is relatively stable in water, but is decomposed by solutions of magnesium salts and of carbonates. A second calcium sulfoaluminate of lower sulfate content is relatively unstable and is consequently believed to have no significance in concrete.

Metaldehyde Developed As Fuel In Germany

REPORTS from Germany say that the Lonz Electric Works have brought out a new fuel under the name "Meta." (See SCIENTIFIC AMERICAN, December, 1928, page 537.) Chemically it is metaldehyde and is produced first by the action of water on acetylene in the presence of mercury compounds. The resultant acetaldehyde is then treated with sulfuric acid in cast-iron vessels at 150 degrees, Centigrade, and metaldehyde is obtained. The heat value of Meta is 6136 large calories per kilogram.

Soap Improves Concrete

THE effect of soap as a water-proofing material for concrete has recently been investigated in Great Britain. For this purpose a comparatively small quantity of soap, amounting to about 0.05 percent of the weight of the concrete is necessary. The soap imparts impenetrability to the concrete by reason of its colloidal swelling in the pores on the surface of the concrete. For a successful product it is necessary that the concrete should not be allowed to dry too quickly. It should be kept damp for at least seven days. This assures against any weakening effect on the concrete, the usual increase of strength being observed after the concrete dries. The usual precautions, however, must be taken to prevent cracking as the soap is not effective in preventing the ingress of water through cracks.

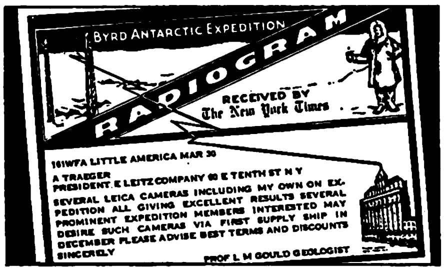
What is pointed out by a writer in *Concrete* as a very considerable advantage derived from this method of water-proofing, is the fact that a block of plain concrete wet on one side expands and gives rise to internal stresses which tend to diminish its strength. The addition of soap, preventing the admission of water, provides some guarantee against this weakening from wetting.

Nitrogen Gas Cuts a Freight Bill

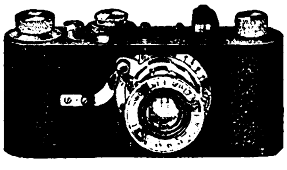
"SOME years ago it was found that silver-ware tarnished in transit" says Arthur A. Maas, writing in his bright little house-organ *Chemistry and You*. "The difficulty was traced to tissue paper, in which the silver was wrapped—chemical analysis showed that it contained sulfur, and we all know what the sulfur in an egg does to a silver spoon.

"The chemist frequently finds work in the shipping room. For example, electrical transformers have been shipped filled with oil, to prevent damage by atmospheric moisture in transit.

"Recently, a large electrical company found that the addition of the oil to some hugh transformers made for California would result in too great weight. What could be used, which would fill the bill, and yet be light enough? Chemists answered that question by filling the sealed transformers with nitrogen, at three pounds


BYRD ANTARCTIC EXPEDITION
RADIOGRAM
RECEIVED BY The New York Times

161WFA LITTLE AMERICA MAR 30
A TRAEGER
PRESIDENT E LEITZ COMPANY 60 E TENTH ST N Y
SEVERAL LEICA CAMERAS INCLUDING MY OWN ON EXPEDITION ALL GIVING EXCELLENT RESULTS SEVERAL PROMINENT EXPEDITION MEMBERS INTERESTED MAY DESIRE SUCH CAMERAS VIA FIRST SUPPLY SHIP IN DECEMBER PLEASE ADVISE BEST TERMS AND DISCOUNTS
SINCERELY
PROF L M GOULD GEOLOGIST


Leica
CAMERA PLEASES
MEMBERS OF THE BYRD EXPEDITION

And a LEICA identical to those on the Byrd Expedition will give you a new and amazing conception of the pleasures of photography.

Always ready for instant use—unaffected by climatic conditions. Smallest roll film camera with Focal Plane shutter. The first camera using Cinema film and giving pictures of double frame size. 36 Pictures on a single load. Enlargements to 12" x 18" or more without loss of detail. Equipped with a Leitz Anastigmat F 3.5, 50 mm. lens. Exposures of 1/20 to 1/500 sec.

See the LEICA at your photo supply store or write for illustrated literature

E. LEITZ, Inc., 60 East 10th St., New York

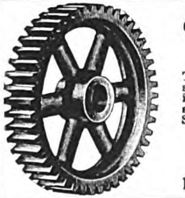
E. LEITZ, Inc.,
60 East 10th Street, N. Y.

You may send Pamphlet 1127 S. A. 3 on the LEICA Camera.

Name..........................

Address..........................

IMMEDIATE DELIVERY
Bond STANDARD STOCK GEARS
Nationally Distributed
Ask for Catalog No. 54-S
CHARLES Bond COMPANY
617 ARCH ST.,
PHILADELPHIA, PA.


GEARS
All Kinds—Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

ELECTRICAL PROBLEMS?
THE A. H. S. ELEC. SERV. & ENG. BUREAU, SPECIALIZING
In Personal Service, will solve them for you with Precision.
P. O. No. 132, FLUSHING, NEW YORK

Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE

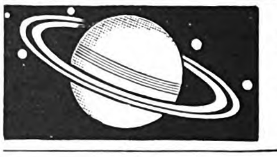
At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.
$5.00 for Complete Outfit Prepaid
ROAT & LOHMAN
Dept. 102 Milton, Pa.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS
MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American
SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.
Books and Information on Patents and Trade-Marks by Request
Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
Labor Saving Machinery Designed & Built
Circular - References - Guarantee - Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City


ASTRONOMICAL
TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.

Auto Specialty Salesmen
Unlimited possibilities with Automatic Decarbonol.
Write GFR, 1830, North Park Ave., Chicago, Ill.

S
AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

IMPORT YOUR OWN GOODS
Pig German Export Magazine published in ENGLISH; offers thousands of bargains in latest novelties; Opportunities for Obtaining Profitable Distributing Agencies. Sample copy 60 cents.
Square Deal Supply Co., F-246 Fifth Ave., New York

1000 NEEDED INVENTIONS
Here is the most remarkable book ever offered to inventors. One Thousand needed inventions listed and described. Arranged as follows: General Problems; Automotive; Mechanical; Electrical; Chemical; Radio; Marine. Separate chapter on the Ten Most Needed Inventions. This book may give you one idea that will win you a fortune. Nothing else like it has ever been published. Compiled at enormous expense. Edited by Raymond Francis Yates, formerly Managing Editor of a leading scientific magazine. Over 100 pages, durably bound. Price $1.25. New Revised 1929 edition. Special Television section.
Send No Money
Cut out this advertisement and send it to us with your name and address plainly written and your copy of this remarkable book will be sent immediately. Pay the postman only $1.25 plus postage on arrival. Money back after 10 days' examination if desired. Limited edition. Write NOW. (Outside U. S. $1.45 cash with order.)
BUREAU OF INVENTIVE SCIENCE
Dept. 107 Rochester, New York

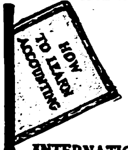
BUSINESS OPPORTUNITY

The Familiar Penny Scale

. . . which you see everywhere

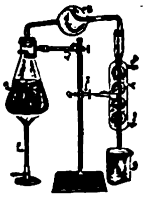
in drug and cigar stores and other places, has been a proven money maker for many years. A concern headed by individuals with 20 years experience in the manufacture and operation of penny actuated scales, offers individuals or groups the opportunity to purchase and own chains of scales of a new and improved type that prints the weight and fortune on a ticket for a penny. Striking in appearance, these scales have demonstrated to earn more by attracting more business. If you are looking for an opportunity to invest your spare funds and are willing to back your money with some of your time, we will be glad to send you a booklet telling more about the opportunities in this proven field. It is a complete proposition with all the facts you need to know. Write Dept. 117, International Scale, 17 East 45th St., New York, N. Y.

ACCOUNTING



The uncrowded, highly paid profession of Accountancy offers marvelous opportunities to ambitious men and women. Send for our 80-page book, "How to Learn Accounting," and the first easy lesson. Both will be sent free.

INTERNATIONAL ACCOUNTANTS SOCIETY, Inc.
A Division of the
Alexander Hamilton Institute
Dept. 58 3411 South Michigan Ave., Chicago, Ill.



CHEMISTS

Catalog listing 2500 illustrations chemists supplies, 5000 chemicals, 1000 scientific books sent for 50c.

LABORATORY MATERIALS COMPANY
637 East 71st Street Chicago

BECOME A FOOT CORRECTIONIST

$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction, not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.

STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

WHY NOT spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies.
MR. SINCLAIR, DEALER IN INSECTS
Dept. 36, Box 1424, San Diego, Cal.

$2 FEMALE
$1 MALE

Why is the LAWYER a Business Leader?

The lawyer is a leader—in and out of business. Great corporations like U. S. Steel—Packard—Standard Oil of Indiana, etc., etc., are headed by law-trained men. Why? Simply because the man with legal training is trained to think and reason clearly, and is accustomed to dealing with facts. Life holds its big rewards for the trained man. Business is based on law, and whether you ever intend to practice or not, the time you spend acquiring law will pay big dividends in income-increasing power.

$10,000.00 A YEAR

"I find that nearly all positions commanding a salary of $10,000.00 a year or more are filled by men who have studied law," writes a prominent eastern manufacturer. Think it over. You can study law at home in spare time. LaSalle offers for home study under its guidance a full law course leading to the degree of LL. B. or a shorter business law course, as you prefer. Price low—terms easy. Write today for free books "Law Guide" and "Evidence." Act at once.

LaSalle Extension University, Dept. 751-L, Chicago, Ill.

pressure. The apparatus reached California in perfect condition, with one and a half pounds pressure of the gas still remaining. And the freight bill on nitrogen was—nothing!"

Imitation Ice for Skating

THERE has recently been developed in Germany a new process for the construction of skating rinks using a floor prepared from chemicals rather than with ice. Although this process is new, it has already been tried out commercially, and the installations to date have been moderately successful, it is claimed.

According to James E. Wallis, trade commissioner, the chemical composition used appears to be soda ash with certain other chemicals added to prevent its solution in water. The ordinary material as it appears on the floor of the rink has the appearance of an almost opaque dirty ice, or may more accurately be described as having the appearance of crude rock salt as it comes from the mines.

Synthetic Building Stone Predicted

HOMES built of coal by-products and permanently tinted in any color of the rainbow were among the wonders predicted recently by Dr. Gustav Egloff and Dr. J. C. Morrell.

"The material is in commercial use," the paper said. "Chemically it is called hexa-tretrame-thylamine. To get it, we take the high boiling tar acids obtained by processing coal and crack them to form carbolic acid. To this we add formaldehyde and ammonia, and obtain the material. Add iron oxide and you get a red material. Add titanium oxide and the resultant color is a beautiful blue. Other dyes and colors may be added, singly or in combination, to obtain the desired colored effect.

"This material is impervious to water, highly resistant to atmospheric corrosion, is a non-conductor of electricity and can be produced cheaper than the granite now used to veneer high steel buildings."

First Aid For Chemical Burns

NO course in first aid is complete these days without some knowledge of the emergency treatment of chemical burns. Such burns may be classified according to acid or alkali source, the former including burns from nitric, sulfuric, muriatic, acetic, oxalic, hydrofluoric, picric, carbolic, and chromic acids. The latter are represented by caustic soda and potash, lime, ammonia, and soda ash.

It is always desirable to determine first whether a burn is acid or alkaline. Litmus paper, wet in water should be used. In either case, then, the burn should be well flushed with water after which it is to be neutralized, in case of acid, with a 10 percent soda solution, and in case of alkali, with weak vinegar (or dilute acetic acid). The bathing of the spot with the neutralizing solution should continue for some minutes. The dressing to be used after neutralization is identical with that for ordinary burns. In certain cases, special treatment is recommended. Chromium burns require immediate treatment with sodium hyposulfite solution. Phenol burns should be washed freely with clean water after which alcohol is applied. Prussic acid burns should be bathed freely in hydrogen peroxide after flushing with water.

To improve your Game
wear a PAL

Pal ATHLETIC SUPPORTER

© B. & B., 1929

Let your mind and body both be free . . . unconstrained. Wear an athletic supporter. Nature left a crucial zone unguarded. Even when you forget the danger, your body remembers.

• • •

PAL is far superior to the ordinary all-elastic supporter. It is porous . . . knit of soft-covered elastic threads. A more *efficient* supporter . . . snug where it should be . . . comfortable all over. PAL doesn't get perspiration-stiff . . . doesn't chafe. At all drug stores . . . one dollar. (*Price slightly higher in Canada.*)

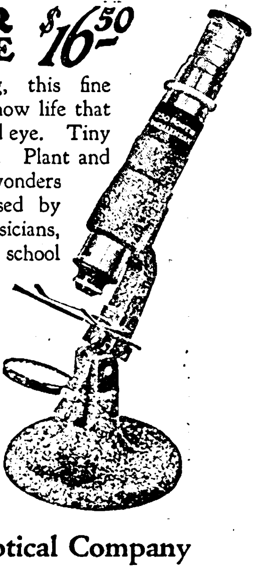
Bauer & Black
A Division of the Kendall Co.
CHICAGO . . . NEW YORK . . . TORONTO
Also makers of the famous O=P=C
For 40 years the leading suspensory for daily wear

250 POWER MICROSCOPE $16.50
MADE IN U.S.A.

Educational, entertaining, this fine microscope helps all to know life that can't be seen with unaided eye. Tiny insects look like monsters. Plant and mineral life reveal new wonders in form and color. Used by students, dentists, physicians, scientists—in home, office, school and laboratory. Precise optical qualities.

Magnifies 100 to 250 times. Tilting stand, fine finish, nickel trim, plush-lined case, prepared slide, instructions. At your dealer or direct postpaid. Money back guarantee. Other models $2.50 to $8.50. Catalog Free

Wollensak Optical Company
912 Hudson Ave. Rochester, N. Y.



Our Choice of Recent Books

Simple Aerodynamics and the Airplane

By C. N. Monteith, Chief Engr. Boening Airplane Co.

A COMPLETELY revised and greatly enlarged edition of a textbook widely used in ground and flying schools and universities and also adapted for home study. The presentation is not highly technical but sound fundamental principles have been developed and applied in a manner suggested by eight years of teaching the subject. 48 pages, 211 illustrations. $4.65 postpaid.

Avigation by Dead Reckoning

By I. E. Elm

A CONCISE practical instruction book, easily understood, to enable a student to master aerial navigation in a minimum period of time. It parallels the instruction given to the pilots of the Army. Numerous diagrams clarify the text which is as simple as it can possible be made. $2.15 postpaid.

Aviation and All About It

By A. Frederick Collins

IN the author's well known style is presented for the youth and layman, the fundamental considerations which must be grasped to understand the principles of flight, how they are worked out, and just what are the salient points that one must observe to get a real understanding of aviation. $2.15 postpaid.

A. C. Radio Guide

By K. A. Hathaway

A PRACTICAL treatise on Alternating Current Radio Tubes, Sets, and Dynamic Loud Speakers and the conversion of D. C. sets to A. C. Short wave reception and receivers is also covered, while numerous diagrams connote the text and illustrate various significant hook ups. $1.65 postpaid.

Television

By H. Horton Sheldon, Chairman of the Board of Physics
E. N. Griswood, Instructor of Physics
New York University

THE subject of television is advancing so rapidly that, as the authors of this book admit, they are faced with the possibility of necessary revision before the volume is off the press. However, they have collected much of the available data, collated them, and selected that material which in their opinion is most pertinent to an undertaking of the present state of the art. The main television transmission and reception systems, such as RCA, Jenkins, Baird, Bell Laboratories, and Alexanderson are described at some length and supplemented by a chapter containing hints of value to those who are experimentally inclined to a sufficient extent to make them desirous of building a radio vision receiver. The book gives no very definite details toward this end, but a careful perusal of it will do much to introduce the reader to the inside workings of television. The introductory chapters dealing with fundamental optical systems, electromagnetic waves, and light-sensitive cells make the book a valuable one for the interested radio man. $2.90 postpaid.

Steel Square Pocket Book

By Dwight L. Stoddard

A PRACTICAL description of the amazing number of solutions that can be demonstrated by the steel square in a number of mechanical lines. Illustrations plentifully correlate the text and the small size will fit any pocket. $1.10 postpaid.

Agricultural Economics

By Fred R. Yode, Prof. Rural Social Science,
State College, Washington

THIS broad consideration of the elements that function in any consideration of present conditions or future betterment, is particularly pertinent because of the country-wide discussion on farm relief. The history of various proposals and a diagnosis is given of what must maintain in any scientific solution. $3.20 postpaid.

General Elementary Botany

By Elmer Campbell, Transylvania College

A GENERAL but fundamental perspective of the plant world divided into three parts, morphophysiology, development, and classification. Practical problems such as blight, weeds, and poisonous plants are indicated, the whole treatment tending to lead the reader into clear and pleasurable botanical observation as well as to inspire a love for accuracy in expressing botanical thought. This grouping is entirely original. Well illustrated. $3.20 postpaid.

English and Science

By P. B. McDonald, Asso. Prof. English, N. Y. Univ.

A WELL conceived treatise on the use of correct and permissible English as applied to written records, reports, and other technical emanations where accuracy can be greatly aided by clarity of style and expression. A much needed guide in a field where haste to record results often evinces a looseness of style bordering on ambiguity. $2.15 postpaid.

Brassey's Naval and Shipping Annual

THE 1929 issue of this most authoritative and essential maritime record represents the fortieth year of publication during which it has been established as the unique reference in this line. There is hardly a question that cannot be answered and one finds library copies well thumbed from consultation. $10.00 postpaid.

For Sale by SCIENTIFIC AMERICAN

A Preface to Morals

By Walter Lippman

A FRANK study of the reasons for our present discontent at the strictures which the religion of our fathers has impressed upon us and a calm attempt to open a door of escape from the chaos of modernity by an analysis of just what traditional morality is, and how we are affected by it whether we will or not. $2.65 postpaid.

On the Bottom

By Edward Ellsberg, Commander U. S. N. (Ret.)

A LUCID and detailed account of the reclaiming of the submarines S-51 and S-4 explaining all the apparatus used, the maneuvering of gear, the personal exploits, and the final success of the greatest salvage exploit of modern times, considered from the standpoint of individual human endeavor. All the romance, heroism, and grim tragedy are splendidly brought out in this book; one of the most interesting we have ever read. $3.20 postpaid.

I Like Diving

By Tom Eadie

NO more rugged, manly, interesting character has appeared in story than the life and accomplishment of this Scotch American. A civilian diver by profession, after he joined the fleet he was recognized by the Navy men as the Master Diver on both the S-51 and S-4 reclamation jobs. By its own honesty of telling and the marvelous feats of accomplishment this story will grip you through to the end. $3.70 postpaid.

Instinct and Intelligence

By R. W. G. Hingston

SEVENTEEN years in the jungles of the Oriental topics furnished the background from which the author draws the conclusions of this most interesting study of insects. Though some of his conclusions will be challenged, the facts upon which they are based are themselves so curious and in many instances startling, that one conclusion is about as well taken as another. One can but admit that the entire book is mighty interesting at least. $2.65 postpaid.

Sex in Civilization

By Thirty Two Eminent Authorities

WE can no more escape the necessity of considering this subject than we can the advance of civilization itself, no matter whether we would like to or not. The distinguished authors who each consider the subject on which they are authorities, frankly and uncompromisingly deal with the facts as science has developed them. The seeker for truth need have no hesitation, for here will be found a treatment which is dignified, moderate, and complete. A work of real value. $5.20 postpaid.

Investment Management

By Dwight C. Rose

A CAREFUL analysis of the fundamental elements of actual investment experience in this country since 1900, in which the author by sound judgment based on experience, sets forth the considerations which must be recognized in any investment management plan. Written for the perusal of the investor himself. $5.20 postpaid.

Old Civilizations of the New World

By A. Hyatt Verrill

FROM actual observation and an intimate knowledge of all available material, the author seeks to weave into one comprehensive account what we know of the earliest history of man in America, bringing together in proper sequence the high-lights of the civilizations and cultures of the Aztecs, Mayas, Incas, and Pre-Incas as indicated by the marvelous monuments which still survive to rival any that the Old World has produced. Interestingly illustrated. $5.20 postpaid.

Nobel

By Ragnan Sohlman and Henrik Schuck

THE life story of the man who made a vast fortune from the manufacture of dynamite and nitroglycerine and then devoted it entirely to the development of world peace. The originator of 355 patents in different countries, he was withal a great pioneer of science, a business man, a friend of humanity, and a great enigma. $5.20 postpaid.

My Life East and West

By William S. Hart

FROM a little boy who spoke the Sioux language like the Indians themselves to the most popular artist whose earnings are counted in millions, the career of this unique personality runs the gamut of human emotions and experiences. No more interesting autobiography could be written. It is as well a picturesque history of the times and peoples with whom he came in contact. Many interesting photographs connote the text. $4.20 postpaid.

Attila

The Scourge of God

By Marcel Brion

THIS is the first modern biography of another of the semi-mythological characters whose lives make such fascinating reading. From his youth as a hostage in Rome to his precipitous death, all sources have been carefully utilized to sustain the accuracy of the narrative, so barbaric and pitiless in its splendor of accomplishment. $3.70 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

For Sleepy Copyright Owners

THE inexcusable delay of a plaintiff in prosecuting his suit for infringement of copyright before a Master, to whom the proceeding has been referred, invalidates the claim for damages. This decision was recently made by the Circuit Court of Appeals for the Second Circuit in the case of D. O. Haynes & Company, Plaintiff-Apellee, versus The Druggists Circular, Defendant-Apellee.

Nine years had elapsed between the first hearing before the Master and a continuation of the hearings before him. Long lapse of time has been held sufficient of itself to prevent relief. Merely instituting a suit does not relieve a person from the operation of the rule of laches, for if he fails to prosecute his suit diligently, it is the same as if no suit had been begun. Laches is defined by the court as meaning neglect for an unreasonable and unexplainable length of time under circumstances permitting diligence, to do what in law should have been done.

Long neglect to take advantage of leave given by a court to assert a right by bill or cross bill may bar the right to file it, and the right to enforce an order of the court may be lost by laches. The doctrine is peculiar to courts of equity, for "he who seeks equity must do equity," and he must "come into a court of equity with clean hands."

"The power of a court of equity is invoked upon the basis of nothing less than conscience, good faith, and reasonable diligence. Chancery courts should not grant aid to a litigant who has negligently slept on his rights and suffered his demand to become stale, particularly where injustice would be done by granting the relief asked," according to the decision.

Foreign Rights to Patents and Trademarks

"PIRATING" of trademarks and patents held by United States citizens has been mentioned in this department upon several occasions. From the numerous appeals received by the Bureau of Foreign and Domestic Commerce as to the procedure advisable against those who are usurping commercial property in foreign countries, it would seem that the necessity for properly protecting trade symbols and patents abroad can hardly be overestimated.

In most countries of Europe and Asia, the original user of a trademark is entitled to it, as in the United States and Great Britain. In the countries of Latin America, the right of exclusive use is usually obtained by registration, regardless of whether the registrant was the first user of the mark. The establishment of the Inter-American Bureau, one of the most commendable activities of the Pan-American Union, will undoubtedly tend to improve the situation in connection with commercial property rights in the various American republics. Numerous cases of infringement have recently been noted in press dispatches, illustrating the too-common tendency to profit by the negligence of owners of valuable commercial property rights.

In Cuba recently the product of an American firm had become so well known that when the firm tried to obtain registration of its trademark the Cuban authorities would not grant the registration on the grounds that the particular mark had become a byword in most homes in Cuba and therefore was not subject matter for trademark protection.

Potential markets are frequently overlooked by manufacturers, and later when an attempt is made to develop the market it is found that the trademark is legally registered as the exclusive property of another person. The confusion resulting from a wide variance in registration methods and different fees can be effectively unravelled only by attorneys qualified in foreign procedure and practice.

Before inventors decide to obtain foreign patents, it is well to investigate the requrements of making, marketing, and disposing of the product within the time specified in the countries wherein protection is sought. The liberal patent laws of the United States are very different from those in most foreign countries. The American patent system is the friend of the poor inventor: no tax is assessed on the patent, contrary to the practice in almost all foreign countries; the inventor is not required to manufacture or offer his product for sale, and he can placidly "sit tight," refusing to permit the public to benefit from his invention for the 17 years that his patent rights remain in force. In many countries, the patent right is forfeited by such inactivity, or for non-payment of the patent tax.

No person or firm is liable for infringement of a United States patent unless the complete infringement has been effected in this country; that is, if all but one of the parts of a patented device are made in this country, and shipped to another country for assembly and the addition of the remaining part, there is no infringement unless the rightful owner of the patent has taken out foreign patents. Devices patented only in this country have been made in other countries and smuggled into the United States for sale here, but if the vendors or users of the infringing devices can be located, they are liable as infringers. The patent franchise grants to the owner the right to exclude everyone else from making, using, and vending the article patented, without the permission of the patentee, *in the United States*. That is the extent of his monopoly.

Yeast Patents Awarded on Appeal

FOR a process of enclosing particles of yeast in milk solids, rather than in gelatin and similar substances used in the prior art, Baylis M. Dawson was awarded a patent upon appeal from the decision of the patent examiner. The examiner had ruled that the applicant had merely followed the teachings of the prior art, in the application of spray drying to the yeast and milk mixture and the selection of milk in place of gelatin because of its higher nutritive value, and that this was not invention but only an obvious expedient such as might be expected of one skilled in the art.

The Board of Appeals refuted this decision, for the reason that it considered the claims justified because the milk increases the nutritive value of the composition as a food product, and acts as a food for the yeast organism. Moreover, the Board upheld the appellant's statement in his specification that milk solids are peculiarly adapted to act as the protective or encapsulating substance for the viable yeast particles, in that they permit dessication of the mixture without injury to the yeast cells.

Certain claims were rejected, including several covering a composition consisting essentially of yeast particles encapsulated or covered by malt extract solids. A prior patent was cited, showing that malt had been listed as a suitable substance to mix with yeast to form a dry yeast composition.

Another patent was awarded to Dawson, consisting of yeast encapsulated with fruit juices instead of, or in addition to, the milk solids mentioned in his other patent. Malt extract solids as an encapsulating material for a comminuted and substantially dry yeast composition were considered old in the art, but the addition of fruit juice to the malt extract solids as an encapsulating material was held to be new.

Inter-American Trademark Bureau

IN compliance with the terms of the Protocol on the Inter-American Registration of Trademarks, signed on February 20th, by most of the countries having membership in the Pan-American Union, there is to be established an Inter-American Trademark Bureau located at Havana, Cuba. It has also been specified that the Bureau shall publish a periodic bulletin providing data and information concerning registration of trademarks and commercial names in the various American countries.

Prior to the signing of the Protocol, the signatories adopted the provisions of the General Inter-American Convention for Trademark and Commercial Protection. The following statement from the draft of the Convention will show its purpose.

"Considering it necessary to revise the 'Convention for the Protection of Commercial, Industrial, and Agricultural Trademarks and Commercial Names,' signed at Santiago, Chile, on April 28, 1923, with a view of introducing therein the reforms which the development of law and practice have made advisable; animated by the desire to reconcile the different juridical systems which prevail in the several American Republics; and convinced of the necessity of undertaking this work in its broadest scope, with due regard for the respective national legislations, (we) have resolved to negotiate the present convention for the protection of trademarks and trade names, and for the repression of unfair competition and false indications of geographical origin."

The new convention provides for equality of citizens and aliens as to trademark and commercial protection in all of the countries signing the pact and outlines regulations for the protection of trademarks and commercial names, and for the repression of unfair competition or false indications of geographical origin and source.

The protocol provides for the establishment of a permanent Inter-American Trademark Bureau, and specifies the procedure to be followed in registering trademarks and commercial names in all of the states concerned. Both the convention and protocol were signed on February 20th by the representatives of the governments of Peru, Bolivia, Paraguay, Ecuador, Uruguay, Dominican Republic, Chile, Panama, Venezuela, Costa Rica, Cuba, Guatemala, Haiti, Colombia, Brazil, Mexico, Nicaragua, Honduras, and the United States. Those desiring copies of the Convention and Protocol may secure them from the Bureau at Havana, Cuba, or from the Pan-American Union, Pan-American Building, Washington, D. C.

Geographical Term Allowed in Trademark

REVERSING the decision of the examiner, who had held that "Semet-Solvay Coke" could not be registered as a trademark because "Solvay" is the name of a town and "Semet" is the name of an individual, the Assistant Commissioner of Patents ruled that the registration was allowable in view of the fact that the words were not reasonably well known as a geographical term and as a surname.

Although there is a village in Onondaga County, New York, which bears the name of Solvay, it was held that it is not a reasonably well known geographical name, as contemplated by the statute. In support of this contention, it was noted that the word "Lakeside" was not considered sufficiently well known as a geographical term to bar its use in a trademark, despite the fact that the word "Lakeside" appears in the Postal Guide as the name of 16 or 17 post offices, and was found to be the name of two incorporated towns of the United States.

The word "Semet" is not generally recognized as a surname. The examiner cited an instance where it appeared as a surname in the St. Louis Directory for 1924, but admitted that it did not occur in the current telephone directories or general directory for the City of New York, nor in the 1928 directory for Washington, D. C. Individually non-registerable words cannot be used in a trademark when in combination, but the decision of the examiner was reversed and both words were allowed.

Capitalism and the Patent System

CAPITALISM—the foundation of the present civilization—is sometimes heralded as the mother of invention. But invention is older than the human race, and capitalism dates from the establishment of the patent system. Under the system, the individual is awarded a temporary monopoly for his creation, whatever it may be, in exchange for exposing his idea to society with instructions which will enable society to practice it and benefit by it. Like Christianity, and the older religions, the essential part of the patent system is the guarantee of a "just reward" for a meritorious accomplishment.

The poets and the philosophers have pictured a perfect state, "where no one shall work for money, and no one shall work for fame." But it is significant that even in the Soviet States of Russia, the capitalistic patent system is accorded an important place, despite their obvious attempt to establish the ideals of communism, or at least socialism. Man seems to have learned that although the desire to create is primary, it is irrevocably allied with the desire for wealth and power and fame. It is also significant that few of the creative contributions which have improved the status of mankind have come from races or individuals who scorn luxury and power. Apparently man does not properly function without the promise of a "just reward."

"What is it that makes the United States a great nation?" asked the Japanese, after Commodore Perry had opened the ports of Japan and the people there began trying to become a great nation. In the words of their Mr. Takanshi, "We looked about us to see what nations are greatest, so we can be like them. There is the United States, not much more than 100 years old. We said, 'What is it that makes the United States such a great nation?' and we investigated and found that it was patents, and so we will have patents."

In the absence of a patent system, corporations could not find the capital to exploit new inventions. Capitalists would not risk such large amounts of money if after a machine is perfected, other manufacturers could copy the perfected machine without undergoing the tremendous preliminary expense. It is the protection to the investment, assured by the patent, that enables investors to get a profitable return for the money they have risked.

Mr. Julius Barnes, former president of the United States Chamber of Commerce, has pointed out that America's predominating industrial position and American ability to pay higher wage scales than other countries rests largely upon our superior invention and patent protection.

"A tool is but the extension of a man's hand," said Henry Ward Beecher, "and a machine is but a complex tool. He that invents a machine augments the power of a man and the well-being of mankind."

Rotarians Guard Their Name

IT is a privilege to use the name "Rotary" on cigars, and that privilege is held by a certain firm licensed to make and sell its tobacco products principally to members of the Rotary Club. This was made clear in a recent decision of First Assistant Commissioner Kinnan, in which he held that Gallagher, Limited, of Belfast, Ireland, is not entitled to register the word "Rotary" as a trademark for tobacco, cigars, and cigarettes.

Although the applicant had registered its trademark in England, the petition was denied here on the ground that the Rotary Club of Chicago had been incorporated prior to the date of the cigar manufacturer's application, and the Rotary Club had arranged with a certain American manufacturer for the use of the word "Rotary" on cigars and tobacco products made principally for the use of Rotarians. The law does not permit registration of any name adopted by an institution, organization, et cetera, incorporated in any state of the United States prior to the date of adoption and use by the applicant.

As interpreted by the First Assistant Commissioner, the "use by the applicant" means use in this country. It is held that use by the applicant in a foreign country, and the registration of his trademark there, cannot avail him of the privilege of using the same trademark in this country. If additional proof of the damage to the Rotary Club had been needed, it was pointed out, the evidence showed that the use by the Rotary Club of the word "Rotary" on cigars and other tobacco products would furnish such additional proof of damage.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

BRAKE FOR AIRPLANES—A drag brake normally affording no projection beyond the under surface of the fuselage, but having means to throw the brake into ground engagement to resist forward movement in landing the plane. Patent 1710628. John H. Kessler.

Pertaining to Apparel

SHOE—Of the turn type, including a shouldered sole shank through which a single seam is formed connecting both sides of the upper to the sole, thus producing a more snugly fitting and stronger shoe. Patent 1709735. Frank Parlante.

NECKTIE CENTRALIZER AND HOLDER—By which a cup-shaped member co-operates with the collar button, hiding the button from view and holding the tie in correct position, while an elastic neck band secures the tie in place. Patent 1708607. Charles J. I. Devlin.

Chemical Processes

LUBRICATING MIXTURE AND PROCESS OF MAKING SAME—An emulsion, consisting of mineral oil and the aqueous extract of the mucilaginous bark of *Ulmus fulva*, may be used in internal combustion engines, will adhere to the metal and greatly reduce friction. Patent 1708058. Preston C. Goss.

Carroting Animal Hair and Wool—By the application to the skin of a 6-10 percent aqueous solution of peroxide of hydrogen and 1-2 percent of bismuth, cobalt or cerium in salt solution, the skin is then dried and ready for further working. Patent 1710565. E. Rich Bohm.

Process for the Manufacture of Therapeutically-Active Iron Preparation Having Yeast as its Basic Substance—Consisting in introducing a colloidal basic iron salt solution into yeast suspended in water, separating the solid substances by filteration, and drying them. Patent 1710584. Cornelius Massatsch.

Designs

Design for a Pendant for Wearing Apparel—Patent 78162. Martin A. Klein.

Design for a Dress—Patent 78214. Dorothy Long.

Design for a Lace Doily—The inventor has been granted two patents for ornamental designs. 78254 and 78255. Ben A. Ball.

Design for a Bathing Suit—Patent 78399. Dorothy Long.

Electrical Devices

Automatic Signaling Apparatus—A manually controlled electric system giving an audible or visual sign in large commercial businesses where it is necessary to call heads of departments visiting various points at a distance. Patent 1707909. Jacob Gullong.

Heating System—An electric heating means whereby the various rooms of a house may be quickly and individually heated to a certain temperature, and the heat regulated and automatically shut off at a predetermined degree. Patent 1708580. Raymond C. Kerlaouezo, Llewellyn W. Evans, and Seward B. Merry.

Device for Indicating Oscillograph Curves as Stationary—Whereby variations in electrical quantities such as voltages or currents, may be observed, and several waves or half-waves may be centered upon a fluorescent screen without destortion. Patent 1707594. Frederick Bedell.

Contact Screw—Comprising a pair of insulating members, a contact point and a fuse wire, which is simple in construction and may be readily applied to any standard house lighting circuit. Patent 1707589. Roy H. Williams.

Fading and Static Eliminating Radio Antenna—Comprising a split ring magnet, a current carrying winding around said metalic ring and a second winding completely enclosing the ring, and a pair of permanent magnets at opposite sides of the ring. Patent 1710085. George W. Cooper.

Of Interest to Farmers

Poultry Feeder—Wherin a guard will readily accommodate itself within a feed hopper and will prevent the fowls from scattering the food, the device may be readily removed for cleaning the trough. Patent 1708838. Clarence E. Hedrick.

Combined Hay Rake, Stacker and Loader—An attachment for tractors operable by the power derived from the vehicle, for lifting hay, alfalfa or other cut grass so that it may be manually dumped onto a wagon, or for stacking the same. Patent 1710632. Otha E. Main and Clarence C. Waughop.

Sanitary Poultry Fountain—So constructed that the reservoir and drinking pan may be easily connected for regular use, or readily separated for cleansing, and may be nested to occupy but little space in shipment or storage. Patent 1711366. Arthur J. Tool.

Of General Interest

Display Stand—Constructed to display a large number of articles simultaneously in such manner that they will be visible individually yet securely held against surreptitous removal. Patent 1707895. Raymond O. Berke.

Cleaning Device—Through which liquids are adapted to be passed and screened to eliminate foreign matter, means being provided to maintain the screened openings clean to maintain a constant flow of the liquid. Patent 1707846. Levin O. Corkran.

Stay for Washable Rugs—In the form of light metal edging strips which permit the rug to remain flat when in use on the floor, but may be easily removed for storing or washing the rug. Patent 1706672. William B. Mason.

Card Carrier for Visible Card Indexes—Comprising a body and a heel member with a central perforation adapted to engage a guide, for general filing purposes, and comparatively more compact than the usual form of card. Patent 1707917. Luigi Lombardini.

Cleaning Device for Eyeglass Lenses—Comprising a pair of cleaning elements supported in juxtaposition to the lenses, removably associated to allow for renewal of the elements, and movable simultaneously to allow for cleaning both sides of the lenses. Patent 1708728. John J. Kilbride.

Sewage-Disposal System—A series of cells designed to receive and automatically promote the spontaneous reduction, and sanitary disposal, of sewage through the agencies of anaerobic and aerobic bacteria always ready to develop under proper conditions. Patent 1708864. Ray M. Birnbach.

Ventilator—Which may be readily attached to a window for allowing fresh air to enter the room, but will exclude rain, and forceful blasts, and will divide the air in a manner to prevent drafts. Patent 1708841. Albert R. Laubenstein.

Food Chopper—For cutting food by hand, the chopper presents a large amount of cutting edge which may be entirely disassembled and the parts taken separately for polishing, cleaning, or sharpening the cutting edges. Patent 1707563. Anna F. Nauman.

Watchcase—Which is the combination of a watchcase and fountain pen cap, in which the watchcase includes mating sections adapted to the associated with the pen cap to constitute a closure. Patent 1709700. William Wishinsky.

Sanitary Container—For tooth brush or other article, having a cap which acts as a container for sterilizing material, and permits escape to the interior of the receptacle when closed, but cuts off escape when removed. Patent 1709625. Harry Martin.

Hair-Waving Device—Comprising a series of interconnected cross sectionally convex members whereby a waving or marcelling of the hair may be produced in a well defined and lasting manner, without injury, or tearing the hair. Patent 1709693. Martha A. Tienken.

Shingle Construction—In the form of a composition shingle having tongues and slots for locking the same, thereby preventing curling, while keeping the tongue itself locked, and thus producing a smooth roof-structure. Patent 1709776. Abbott Coburn.

Bedcover - Holding Device — Whereby clamps and adjustable members are attached to the bed spring frame providing securing means for the blanket and other bed covering to prevent the same pulling loose at the sides and foot of the mattress. Patent 1709275. Benjamin A. Moeller.

Valve Box—Comprising a lower section in the form of a sleeve, and an upper section telescoping within the lower section and adapted to be interposable between a subterranean pipe line and the surface of the street. Patent 1710571. Natale Forni.

Map Holder—Wherein a container is formed with a transparent face for the reception of a sheet or folded map, and a manually actuated pointer is associated with the cover for shifting from one point to another. Patent 1710555. Salvatore Tascarella.

Mailable Matter of Envelopes—Having temporary connecting means whereby they are integrally joined together so as to form substantially a continuous sheet, whereby a typist may easily address them, and they may be moistened and sealed in short time. Patent 1710603. Stella Benenato.

Ice - Cream - Freezing Cylinder—A refrigerating construction by virtue of which the freezing mixture may circulate rapidly and continuously so as to shorten the freezing time and thereby lessen costs. Patent 1710648. Emery Thompson.

Combination Furniture—More particularly a combination desk or table and chair, which may be folded into small compass for transportation or storage, readily portable, and particularly useful in army, or field service, or rural schools. Patent 1711373. Abelardo De A. Casanova and Octavio A. H. Posada.

Smoking Pipe—Having at the bottom of the bowl a chamber for collecting saliva, which may be readily cleaned, the smoke passage through the stem being entirely independent, and out of communication with the saliva chamber. Patent 1711435. Kenneth M. West.

Drier and Steamer for Tubular Fabrics—An assemblage consisting of a drying shell, means for drawing the fabric over the shell inside a drum and an inlet and outlet for the drying air, thereby effecting the steaming and drying in one operation. Patent 1711094. Maurice M. Kasanof.

Hardware and Tools

Combination Door Hinge and Check—In which pneumatic means and spring means are associated in a unitary device to effect a noiseless closing with a minimum strain on the device in order to maximize its durability. Patent 1706656. Nathaniel T. Collins.

File Holder—For supporting a flexible file so that it can be manually actuated with accuracy and adjusted to adapt itself to the shape of the object to be operated upon. Patent 1707207. Valentino L. Bianch and George A. Holsberg.

Bolt, Shaft and the Like—Comprising a helically wound resilient member which is tubular in form and capable of expansion and contraction, dispensing with lock nuts, the bolt itself exerting a pressure to hold the parts coupled. Patent 1708793. Allan H. Jones.

Door Lock—Having a latch bolt capable of actuation from either side of the door, a locking member operable to prevent actuation of the outer knob, and a key for operating the bolt from the outer side. Patent 1707413. Kenneth A. Pendleton.

Rotary Underreamer—For increasing the diameter of a well after the usual reamer increases the depth, by forcing cutting blades into the wall simultaneous with the advance of the reamer which increases the depth. Patent 1710580. George F. Le Bus.

Band Saw and Pulley Therefor—Which affords a uniform support and tension as the cutting edge of the saw is worn down and its width decreased, and maintains the saw in its proper operating plane and against slippage. Patent 1711374. James J. Chapman.

Device for Holding Moldings—A support for a molding during the cutting or planing operation, which is capable of such adjustment that it may be made to fit all points of the surface and will prevent vibration or misalinement. Patent 1711342. Russell G. Dishman.

Securing Means for Corrugated Building Sheets—Consisting of a clamp generally of U-form which provides a support beneath the corrugated sheets effecting a stronger and more secure attachment, easy of application, light in weight and of comparatively low cost. Patent 1711415. Louis Lane.

Heating and Lighting

Apparatus for Altering the Shape and Size of a Projected Beam of Light—Particularly adapted to be used in an optical projection machine, and including adjustable shields for illuminating a field of vision or a particular object from a distance with a projected beam of light. Patent 1709626. Harold A. McGunnigle.

Furnace Using Forced Draft—Having automatic means for controlling the air blast in response to the steam pressure, collecting the unburnt gases and returning them to the fire box, and reducing the consumption of fuel to a mimimum. Patent 1709800. Elmer A. McArthur.

Machines and Mechanical Devices

Outboard Motor—Of the twin screw type, embodying a two cylinder two cycle balanced stroke engine driving the two screws with materially less vibration than is commonly found in operating a single screw. Patent 1707897. Gaston Bizet.

Stapling Machine—For cutting blanks from a strip of material, forming staples and setting the same, will form an appreciably great number of staples without refilling, and is practically immune from clogging. Patent 1708730. Alexander Z. Kruse.

Throw-Off Device for Vienna-Roll-Forming Machine—Wherein a series of dies are adapted to make imprints on the rolls while in the form of dough, and the rolls are automatically ejected immediately after being formed. Patent 1708758. Charles Gottfried.

Edge-Trimming Machine—A single instrument for cutting the grass and plowing to a certain extent some of the soil adjacent thereto, so as to present a clean edge between the lawn and the walk. Patent 1708768. Albert W. Marsik.

Cable-Operating Machine—Wherein pairs of coacting jaws make use of a relatively small force to produce a strong pull on an associated cable, and prevent slipping, in yarding logs and hoisting heavy objects. Patents 1708880. Cecil Gross.

Fruit and Vegetable Washing and Drying Machine—In which the fruit or vegetables are washed by a spray as they are discharged into a revoluble hopper, which is subsequently rotated to dry the fruit or vegetables by centrifugal action. Patent 1708721. Joseph T. Evans.

Apparatus for Treatment of Deciduous Fruit—For thoroughly removing or neutralizing all traces of arsenate of lead from the fruit, so that when subsequently washed and dried, the fruit will be clean and ready for the market. Patent 1707610. August Guignard, August Bosse and John Guignard.

Floor-Polishing Machine—Which may be operated, when necessary, to vary the degree of vertical pressure exerted by the brushes upon the floor, provides easy access to the working parts, and protects the operating mechanism. Patent 1707575. Henry E. Schooling.

Fitting—For boilers, comprising coupling members having axial openings and opposed seats, a ball mounted in said seats, composed of semi-spherical sections, having semi-cylindrical opening, whereby a three-way fitting is provided. Patent 1709624. Alva A. Lindley.

Scum Eliminator—Adapted for use in the manufacture of cane sugar, to aid in separating from the cane juices, and carrying off, that portion of the matter in suspension which is lighter than the juice. Patent 1709783. James C. Etheredge.

Device for Forming Multicolored, Braidlike Decorations—A device for causing the twirling and ejecting motion of a plastic substance, and regulating the degree of tension, thereby giving the desired pitch of the strands to produce a decorative braid-like form. Patent 1709280. John A. Ost.

Refrigerator and Dispensing Device—A rotatable storage device for maintaining a plurality of bottled liquids in a cool condition, the bottles being placed in an accessible position by the insertion of a coin and the manipulation of a rod. Patent 1710621. John E. Henderson.

Sand-Tester Pump — Which may be raised or lowered by the drill pipe for forcing fluid from the sand, and in which a suction is created to remove mud and water from the sand. Patent 1710581. George F. Le Bus.

Liquid-Dispensing Apparatus—Particularly for use at gasoline filling stations, there being an arrangement whereby various quantities of gasoline are stored ready for immediate dispensation for a given amount of money, the fluctuation in price being taken into account. Patent 1711331. Thomas B. Smith.

Article-Shaping Apparatus—By pressure of air and an expansible die with which a plunger cooperates to compress air in a receptacle and forces the walls against the faces of the die to shape the article. Patent 1711445. Benjamin Burvenick.

Mechanical Aid for Reading and Writing—A desk which is vertically and angularly adjustable, together with rests for both arms, whereby the user will be helped to remain in upright position so that the eyes will be correctly focused while reading or writing. Patent 1711360. Vadakkath R. Menon.

Medical and Surgical Devices

Syringe—Including a barrel, a piston movable therein, a hollow piston rod, a manually controlled plunger valve and yieldable rubber rings which eliminate the necessity of packing, and provide a leak-proof structure. Patent 1707880. John H. Sheets.

Prime Movers and Their Accessories

Liner for Valve Seats—Adapted to be inserted in a recess in the intake or exhaust passage of a cylinder block, after said passage has been re-bored, to form a recess with bevelled edge to properly seat the valve. Patent 1709807. Theodore S. Purnis.

Humififier for Internal-Combustion Engine—Adapted to be attached to an old motor or built into a new one, for delivering steam, in small quantities thereby enriching the mixture, giving more power, and a smoother-running motor. Patent 1711408. Frank H. Fritz.

Pertaining to Recreation

Playground Apparatus—Permitting the healthful exercise of children, which includes units presenting horizontal climbing rungs, and a sliding member supported thereby, may be readily erected and transported in a knock-down condition. Patent 1707854. George J. Hanlon.

Playground Apparatus—Which includes a horizontal ladder, diagonal ladders, an elevated platform and a slide, all combined in a minimum of space and in a manner to render the apparatus safe and amusing for children. Patent 1708883. Frank B. Hedges.

Stuffed Figure Toy—So constructed that it will have no breakable parts to penetrate the cover, the body and limbs being yieldable and flexible yet sufficiently rigid to remain in the position placed. Patent 1708170. Hasseltine M. Dickins.

Amusement Device—Comprising a plurality of multi-faced members which may be matched together to form a number of complete pictures or representations of an object, which is of educational value as well as entertaining. Patent 1709660. Joseph de Bracht.

Game Apparatus—A target simulating a natural head having teeth in an opening, the object being, in exercising skill at throwing, to knock out as many teeth as possible, with an allotted number of balls. Patent 1709420. Charles Weisser.

Figure Wheeled Toy—Embodying a cart and a walking figure arranged to simulate pulling the cart, wherein the legs and other movable parts of the figure will possess life like movements when pulled over a plane surface. Patent 1711376. Edward J. Darling.

Railways and Their Accessories

Expansion Rail Joint—By means of which the abutting ends of rail sections may be securely held down to their tie, or other base, against lifting or spreading, while permitting relative longitudinal expansion and contraction therein. Patent 1710557. Victor Walker and Philip Kaplan.

Pertaining to Vehicles

Tire-Rim-Contracting Device—Which will hold the rim in contracted condition while the tire is being removed and replaced, and until released to return to its normal condition. Patent 1700719. Samuel H. Savage, 540 34 St., North Bergen, N. J.

Accelerator—Including a base and a pedal for operating the accelerator of an automobile, the device is simple and adapted to be emplaced by the owner. Patent 1700643. Carl Nordell.

Ventilator—A combined buffer and ventilating device, comprising a channel-shaped shield adapted to be connected with, or part of, the sliding sash of a closed vehicle, to permit ventilation but prevent rain from entering. Patent 1707888. John S. White.

Accelerator Pedal—Which may be readily attached to an automobile, and when in operative position provides an easy and comfortable foot rest which will maintain a non-frictional contact with the accelerator button. Patent 1708820. Charles B. Wright.

Rotary Antiskid Chain for Vehicle Wheels—Easily applied to or removed from one of the road wheels, to carry an endless anti-skid chain encircling the wheel and a spool to set up a more effectual anti-skidding action. Patent 1708755. Charles H. Dierksmier.

Jack—For use with automobiles, in which the turning movement is multiplied to impart a rapid and maximum lifting from relatively short members, so that the jack when collapsed will occupy small space. Patent 1708717. Sydney P. Barker.

Direction Indicator—A hinged signal, a reciprocating piston operating subject to the suction of the engine, and a valve control within reach of the driver, for retaining the signal in active position during the movement indicated. Patent 1708606. John Clifford.

Safety Device for Automobiles—A combination structure whereby the gas and ignition are both turned off, and the hood locked closed by a single operation, thus eliminating key losses, and preventing theft of the car. Patent 1709717. John P. Geraghty.

Automobile Signal Switch—Having means for signalling either right or left hand turns, the switch mechanism operating either an audible or visible signal, or both, whenever the driver swings the wheels any material distance in either direction. Patent 1709806. Honorino Pereira.

Instrument for Gauging the Rate of Acceleration or Deceleration of Vehicles—A light case supported on a pivot and partly filled with liquid, the transference of the liquid, by its weight, from one part of the case to another, indicating the rate of acceleration or deceleration. Patent 1710594. William Tapley.

DRAFTING

Learn at Home

Drafting is one of the best professions a young man can choose because it pays good salaries and it is the stepping stone to even better positions. Many leading architects, mechanical engineers and electrical engineers got their start at the drafting board.

There is no easier way to learn Drafting than through the home-study courses of the International Correspondence Schools. The practical value of these courses is shown by the success of I. C. S. students and also by the fact that employers are constantly writing us for trained men. We receive more calls for I. C. S. draftsmen than for graduates of any other course.

F. E. King was "a poorly paid clerk" when he enrolled for the I. C. S. Drafting Course. By study, industry, and perseverance he became Chief Draftsman of the U. S. Steel Furniture Company, of Syracuse. He is now earning more in a day than he used to earn in a week.

A. J. Hutchins became Chief Draftsman for the American Strawboard Company and increased his salary 300%—also as a result of I. C. S. training.

There is no doubt that Drafting offers a real opportunity to ambitious men and it will pay you to investigate it. Just mark and mail the coupon and we'll gladly send you a booklet telling all about the I. C. S. courses in Drafting or any other subject in which you are interested.

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 6108-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, **"Who Wins and Why,"** and tell me how I can qualify for the position, or in the subject, *before* which I have marked an X:

☐ **Mechanical Drawing**
☐ **Draftsman's Course**
☐ **Structural Drafting**
☐ **Architectural Drawing**

☐ Architect
☐ Building Foreman
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Engineer
☐ Electrical Engineer
☐ Electrical Contractor
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Telegraph Engineer
☐ Telephone Work
☐ Mechanical Engineer
☐ Machine Shop Practice
☐ Toolmaker
☐ Patternmaker
☐ Civil Engineer
☐ Surveying and Mapping
☐ Bridge Engineer
☐ Gas Engine Operating
☐ Automobile Work
☐ Aviation Engines
☐ Plumber and Steam Fitter
☐ Plumbing Inspector
☐ Foreman Plumber
☐ Heating and Ventilation
☐ Sheet-Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration Engineer
☐ R. R. Positions
☐ Highway Engineer
☐ Chemistry ☐ Pharmacy
☐ Coal Mining Engineer
☐ Navigation ☐ Assayer
☐ Iron and Steel Worker
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Agriculture ☐ Fruit Growing
☐ Poultry Farming
☐ Mathematics ☐ Radio

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C. P. A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Grade School Subjects
☐ High School Subjects
☐ Illustrating ☐ Cartooning
☐ Lumber Dealer

Name..
Street Address..
City.................................... State....................
Occupation..

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian Limited, Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—JULY, 1929

American Pipe Bending Machine Co.	85
American Telephone & Telegraph Co.	85
American Tobacco Company	Fourth Cover
Apparatus Engineering Co.	86
Bauer & Black	89
Bernard & Heller	88
Charles Bond Company	88
Box 190	85
Bureau of Inventive Science	88
Chicago Stock Gear Works	88
Elec. Service & Eng. Bureau (P. O. Box 132)	88
Ethyl Gasoline Corporation	1
General Electric Company	2
Alexander Hamilton Institute	89
International Correspondence Schools	96
International Ticket Scale Corp.	89
Keasbey & Mattison	86
Otto Konigslow Mfg. Company	85
Laboratory Materials Company	89
La Salle Extension University	89
E. Leitz, Inc.	88
Masonite Corporation	79
Metallic Sign Letter Co.	88
Wm. Mogey & Sons, Inc.	88
Munn & Co.	87 & 88
New Method Mfg. Company	87
Packard Motor Car Company	Third Cover
Pioneer Press	83
Roat & Lohman	88
Ronald Press Company	84
G. F. R.	88
Schwerdtle Stamp Co.	87
Science News Letter	96
Charles A. Scott	88
James Sinclair	89
Square Deal Supply Company	88
Stephenson Laboratory	89
Studebaker Corp. of America	81
Timken Roller Bearing Company	Second Cover
Unisol Mfg. Company	85
Veeder-Root, Inc.	87
Wollensak Optical Company	89
Henry Zuhr Inc.	88

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
LOUIS S. TREADWELL, Vice-President
JOHN P. DAVIS, Treasurer
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

Albert A. Hopkins
Albert G. Ingalls
Louis S. Treadwell
A. P. Peck
F. D. McHugh
Henry W. Hough
Professor Henry Norris Russell
Professor Alexander Klemin

CORRESPONDING EDITORS

Ernest W. Brown, Sterling Professor of Mathematics, Yale University.

A. E. Buchanan, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

Morris Fishbein, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

William K. Gregory, Professor of Vertebrate Paleontology, Columbia University.

Leon A. Hausman, Professor of Zoology, New Jersey College for Women.

Paul R. Heyl, Physicist, United States Bureau of Standards.

David Starr Jordan, Chancellor Emeritus, Leland Stanford Jr. University.

Waldemar Kaempffert, Director Rosenwald Industrial Museum, Chicago.

M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MacDougal, Associate in Plant Biology, Carnegie Institution of Washington.

Roy W. Miner, American Museum of Natural History.

Russell W. Porter, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

Dr. Walter Franklin Prince, Research Officer, Boston Society for Psychic Research.

Elihu Thomson, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. Wood, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 1. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

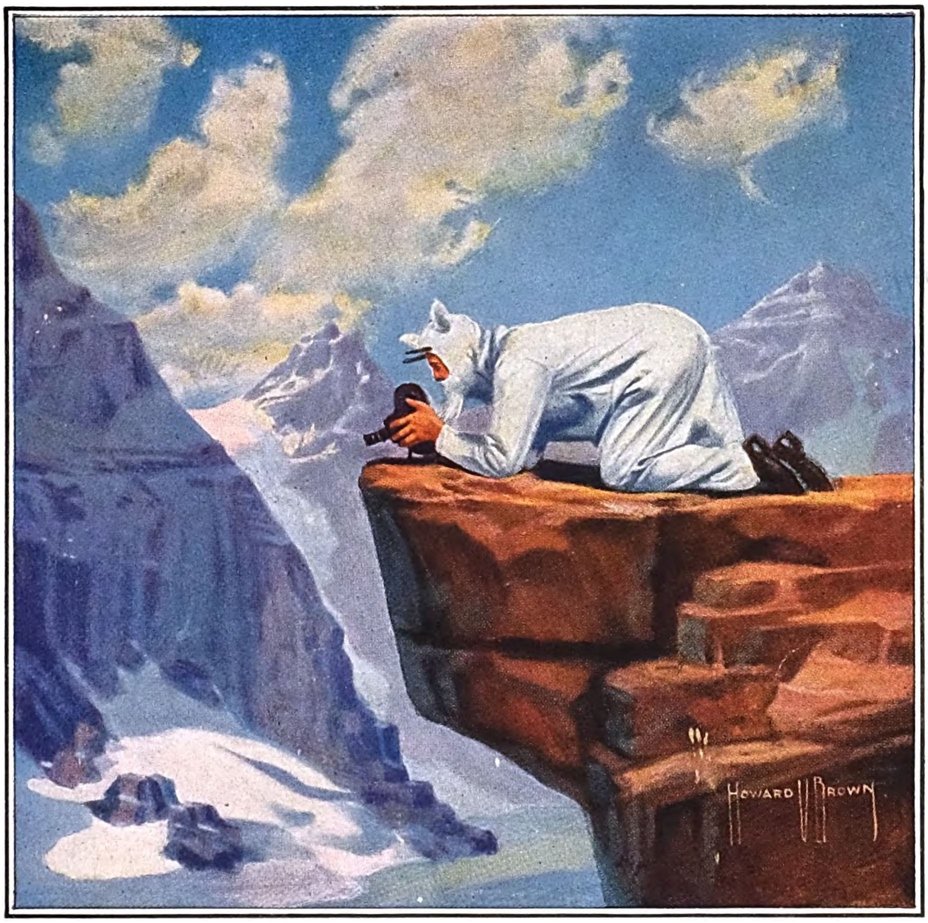
05 Engng
7

NATURAL HISTORY NUMBER

SCIENTIFIC AMERICAN

August 1929

35¢ a Copy



JUL

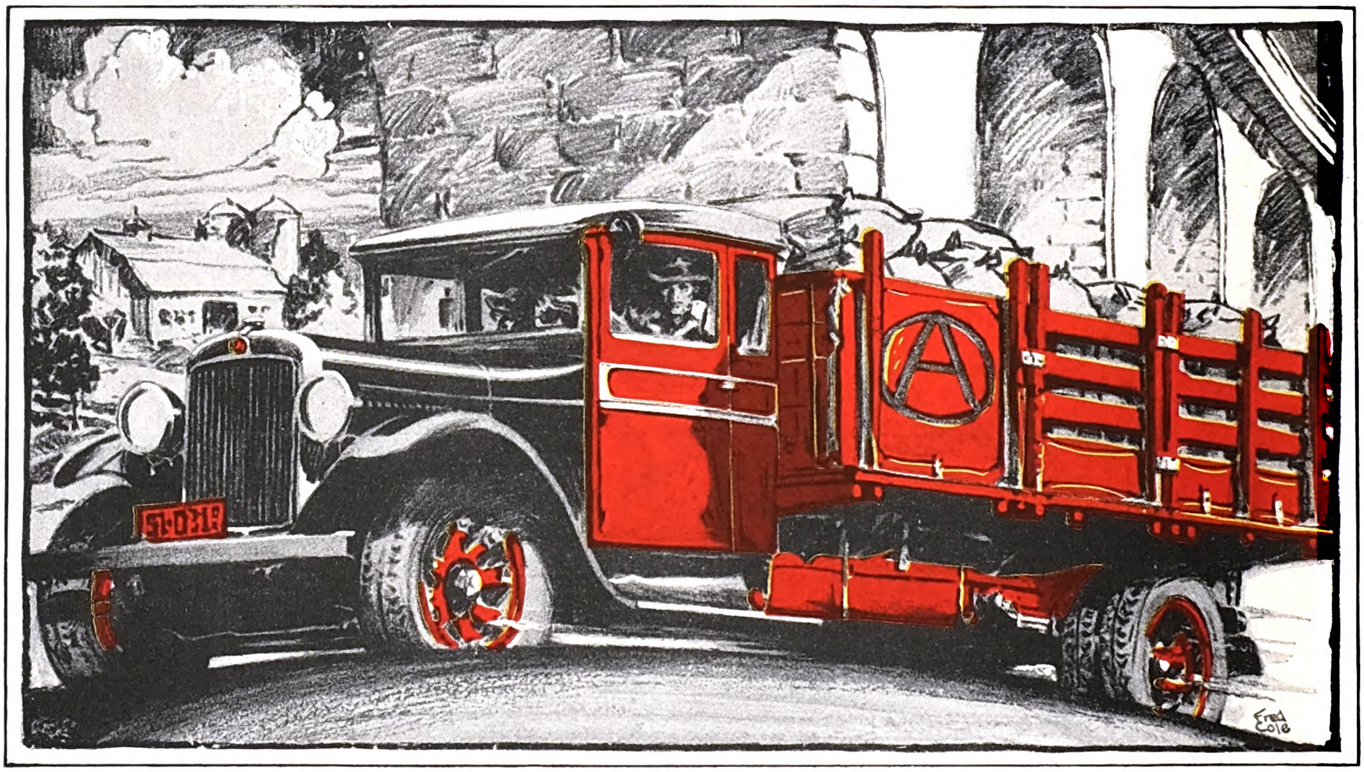
‘SHOOTING’ WILD LIFE WITH A CAMERA

CROP-DESTROYING INSECT PESTS

SNAKE STORIES SHATTERED

DODGE BROTHERS TRUCKS

CHRYSLER MOTORS PRODUCT



For your greater profit put Dodge Trucks to work . .

WORK is the sole function of any motor truck as profit is the ultimate aim of any business. Work—its quality, its quantity, its cost—must be the true measure of motor truck value.

From drawing board through to factory gate, the experienced brains and skilled hands of the builders of Dodge Trucks are guided by consideration of the work each truck must do for an owner. And world-wide Dodge Brothers Dealer service is ready, always, to keep them at work.

Hundreds of thousands of Dodge Brothers Trucks are in use by owners who prefer Dodge Trucks. Repeated purchases prove this preference. Each appraises work in his own way—miles run, packages delivered, tons hauled, power, speed, economy, reliability, freedom from layup, expansion of business territory. But each thinks of work finally in the same terms—profit earned . . . For your greater profit—whatever your trucking needs—put Dodge Trucks to work for you.

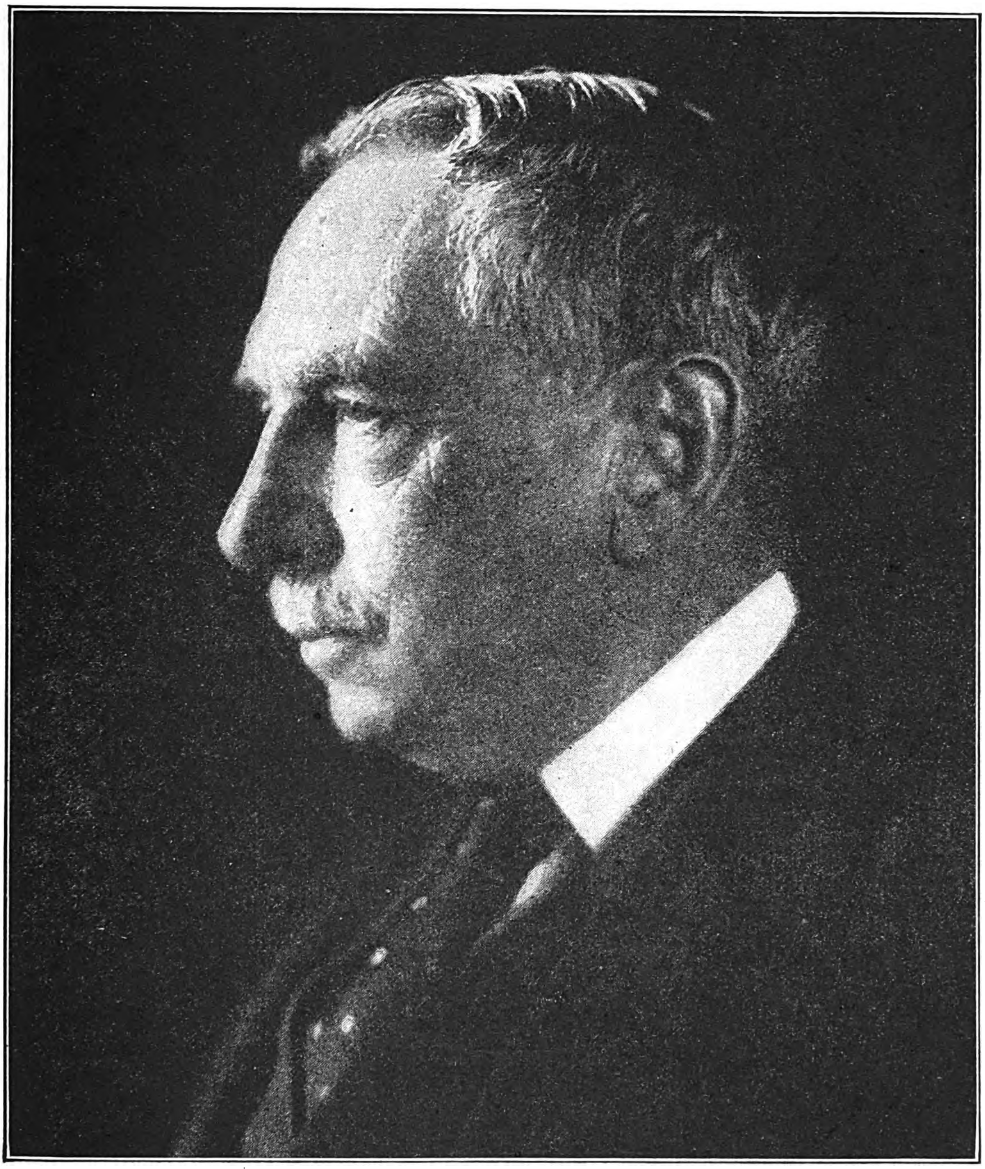
A NEW 1-TON
At a New Low Price

Inspect the new Dodge 1-Ton Truck . . . . Powerful 4-cylinder engine . . . . Safe, internal-expanding, hydraulic 4-wheel brakes . . . . Quality through and through at the lowest price for which a Dodge 1-Ton has ever sold.

. . .

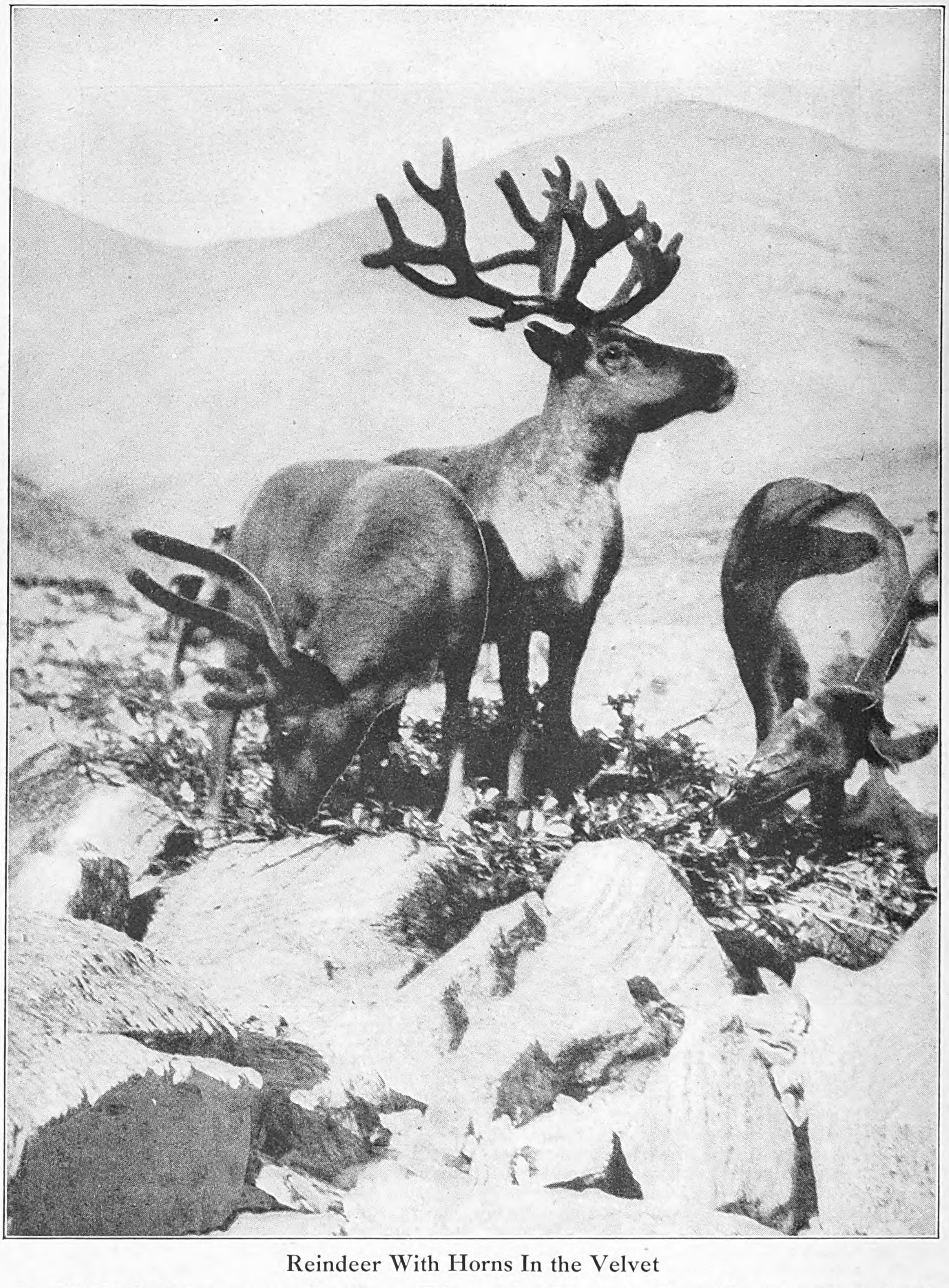
Dodge 6-cylinder trucks range in size from ¾-Ton to and including 3-Ton. There is a 4-cylinder Dodge Merchants Express for ½-Ton loads.

SOLD BY DODGE BROTHERS DEALERS EVERYWHERE



Henry Fairfield Osborn

PROFESSOR HENRY FAIRFIELD OSBORN, noted paleontologist, student of evolution and President of the widely known American Museum of Natural History, is also President of the American Association for the Advancement of Science, the great general organization which, with its 18,000 members, includes the entire professional personnel of the several branches of science in America. Most of Professor Osborn's distinguished career has centered around the study of organic evolution, as the following reckoning of his very many published scientific papers makes evident: In geology 14 papers; in zoology 35; in comparative anatomy 24; in eugenics 3; in anthropology 30; on evolution 77; in paleontology 285; in psychology 5. Among his best known books are, "From the Greeks to Darwin," a complete survey of pre-Darwinian theories of evolution; "The Age of Mammals," a study of the immense development of mammalian life, including many extinct types, in the Tertiary and Quaternary times of the geologist; "Men of the Old Stone Age;" a standard treatise on prehistoric man; "The Origin and Evolution of Life," a study of organic evolution. Of honors, scientific awards, decorations, degrees and medals he has received a lengthy list. Among scientists Dr. Osborn is best known because of his studies of the great mammals, especially the proboscidians, including the mastodons, mammoths, and modern elephants. In 1925, at the time of the famous Scopes evolution trial in Tennessee, he became widely known to the newspaper reading public because of his championship of the cause of evolution, and his opposition to Mr. Bryan and his followers.



Reindeer With Horns In the Velvet

A TRIO of reindeer, summer browsing. This photograph was taken within a few miles of Cape Prince of Wales, Alaska, the westernmost extremity of the North American continent. While the antlers are growing they are said to be "in the velvet," because of the soft membrane and velvety fur in which they are enclosed. Both sexes have horns which are shed annually. The central pair above are a doe and fawn. The fawn is three months old. Note the "swallow fork," a slit in the ear of the middle reindeer, which is an ownership mark.

All photographs courtesy Lomen Brothers

A HERD COMES IN FROM THE RANGE

The largest reindeer herd in Alaska today is many times the size of the largest cattle herd in the United States. Reindeer increase rapidly and with careful handling should double in number every three years—partly due to the hardihood of the fawns

Reindeer as a Source of Food

Vast Pasturages in Alaska Can Support Five Million Reindeer to Supplement Our Decreasing Cattle Supply

BY CARL J. LOMEN

A PATERNAL ACT performed by our government, of introducing the domesticated reindeer into Alaska to improve the living conditions of its wards, the Eskimos, unexpectedly opened a new field for the American stock raiser. It extended the grazing limits of the United States far to the north, adding some 350,000 square miles to the pasturages of our country.

The introduction and raising of the reindeer in Alaska is one of the most constructive efforts ever attempted on the part of our government for the betterment of Alaska and the condition of its people.

America owes its reindeer population to Dr. Sheldon Jackson, United States general agent of education in Alaska. Dr. Jackson made a cruise of northern waters in 1890 on board the Revenue Cutter *Bear*. He found the Siberian native peoples on the west shores of Bering Sea independent due to their herds of domesticated reindeer, while across the waters on the American side the Eskimos were eking out a precarious existence and annually facing starvation due to their dependence on fishing.

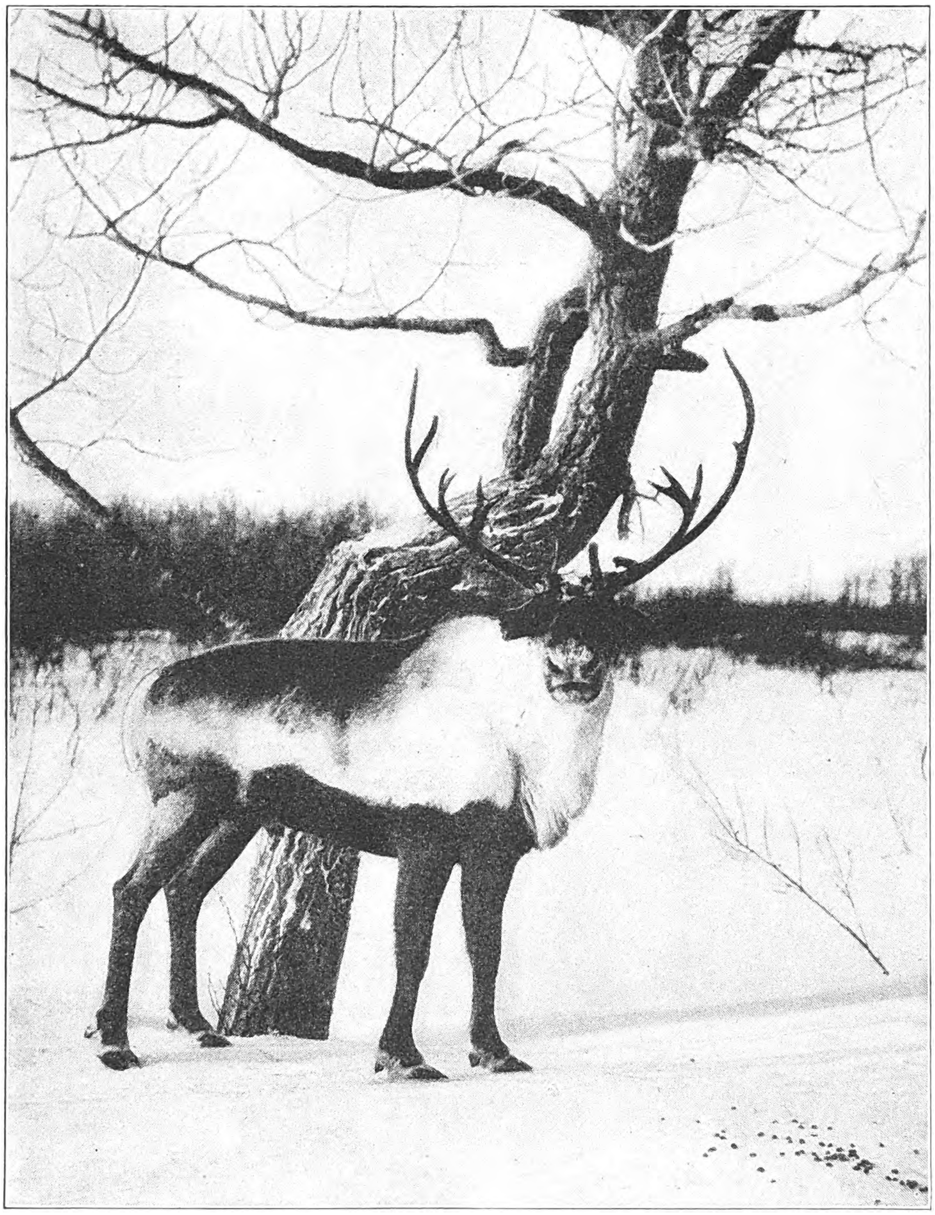
Returning to Washington, Dr. Jackson made recommendations to the government, through the Commissioner of Education, urging that reindeer be introduced into Alaska. Pending the securing of a Congressional appropriation, an appeal for funds was made to the general public, through the press and the churches. In this way 2146 dollars were collected, with which were purchased 16 reindeer in 1891 and 171 in 1892. The latter constituted the first of the "mother stock" of the vast herds of today, the 16 secured in 1891 not being breeding stock.

IMPORTATIONS continued until 1902, Congress appropriating the necessary funds, the Revenue Cutter Service co-operating with the Bureau of Education in the purchase of the animals and in their transportation from Siberia to Alaska. The importations totaled 1280. These were all landed on the shores of Port Clarence Bay, near the present location of the thriving little town of Teller.

The reindeer found in Alaska a more equable climate, abundance of forage, and uncontaminated pasturage than in Siberia, and also a lack of natural enemies. They throve, grew larger, and rapidly multiplied. By 1905 the natural increase had brought the number to 10,000. There were 70,000 in 1915, 200,000 in 1920, and by July 1, 1929, there were more than 1,000,000. In addition to this number, more than 300,000 have been used for food and clothing.

It was one thing to bring reindeer to Alaska, but it was quite another problem to train the nomadic hunter of the north in the art of animal husbandry. To make a herdsman of the hunter is a difficult task.

Through the Bureau of Education an apprenticeship system was established. Intelligent young Eskimos were selected and placed with the herds. To assure the success of the enterprise a number of Laps, together with their families, were brought over from northern Norway to teach reindeer husbandry. Four years was the period of apprenticeship and payment



KING OF THE HERD

The reindeer has been man's most valuable domesticated animal in northern Eurasia for centuries past, furnishing both food and clothing. Reindeer meat is now on American menus

for services was made in reindeer and supplies. At the expiration of the four year period the apprentice owned in his own right a small herd of reindeer and moved on to his own range, but still subject to Bureau regulations. The new owner must in turn employ Eskimo apprentices and distribute reindeer to them, as partial payment, thus becoming an additional factor in the extension of the enterprise. To safeguard the industry for the Eskimos, the regulations forbade the disposal of female reindeer to others than Eskimos.

The Lap instructors were reindeer men familiar with the growth of reindeer herds in northern Europe and would not accept employment in Alaska until assured that our government would assist them in establishing herds of their own. Contracts were entered into which provided for the loan of 100 reindeer, a like number to be returned to the govenment at the expiration of five years, the Lap keeping the natural increase.

Illustrative of the rapid growth of reindeer under good management, the following concrete example is given:

In 1901, the Government loaned to Alfred Nilima, a Lap, 24 male and 75 female reindeer. In 1906 Nilima returned 99 animals, keeping the increase. In 1908 he divided his herd of 800 with his Eskimo wife, keeping 400 for himself. As the herd grew, Nilima employed other Laps as herders, paying them, in part, with reindeer. In 1914 he sold his herd, which then numbered 1200. In 1917 his former herders sold 1717 and an additional 1606 in 1921. All this from the natural increase of 99 reindeer.

Through the apprenticeships and Lap contracts many herds were established and, as the reindeer increased in numbers, it became necessary to seek more ranges. Some owners drove their herds north and others south along the coast. Today the country is dotted with herds reaching from the northernmost part of Alaska to the Pacific Ocean and from the Bering Sea coast to the interior along the belt traversed by the Alaska Railroad.

A million reindeer! That number cannot be maintained only as a food supply; a cache from which to feed some 10,000 Eskimos. Including the Indians, the native population of Alaska is less than 30,000. The reindeer population is nearly 35 times as great. Include the white population with the native and we have 20 reindeer for each person in the territory of Alaska. Reindeer herds are increasing at the rate of 39 percent per year. With a grazing area of 350,000 square miles and a grazing unit of 30 acres, Alaska can permanently support more than 5,000,000 reindeer.

THE vast herds are no longer maintained for the sole benefit of the natives, and our Federal Government no longer looks upon it solely as a protection against the starvation of its wards, but also in the light of a promising industry which can be counted upon to produce millions of pounds of meat to augment the declining meat production of the United States and to contribute largely to the productive wealth of its northern treasure chest.

In 1914 there was a large and increasing surplus of animals in many of the herds and the commercial development of the industry became desirable. The same year the first of the Lap contracts expired and the government encouraged the white citizens to enter the industry. A small group of citizens of Nome, Alaska, organized a company and entered upon the work of developing commercially this great and promising industry.

There were many difficulties to meet. The Laps and Eskimos were not progressive and had always been satisfied with their reindeer and ranges without thought of improvement to either. The whites soon learned that many changes were necessary to place the industry on a sound basis. Central stations and many shelter cabins had to be established on the ranges for protecting the herders, and improved corrals, with chutes and runways were constructed for protecting the reindeer. Preparing the meat for market required modern abattoirs and ammonia cold-storage plants, and the transportation of the meat from Alaska to the markets of the United States necessitated ships equipped with refrigerating plants.

In 1920 a Congressional appropriation made it possible for the Bureau of Biological Survey of the Department of Agriculture to extend its work to

Alaska and a Reindeer Experimental Station was established. Grazing and health problems were studied and the industry aided along scientific as well as practical lines.

The whites were interested in the development of better animals, and, in co-operation with the Biological Survey, commenced to improve the herds by eliminating scrub stock and by cross-breeding with the American caribou. As a result of the latter experiment it is already found that the half breed fawn is heavier, at birth, than the full-blood reindeer or caribou fawn. Care must be exercised in this work to prevent breeding into the reindeer too much of the migratory instinct so highly developed in the caribou.

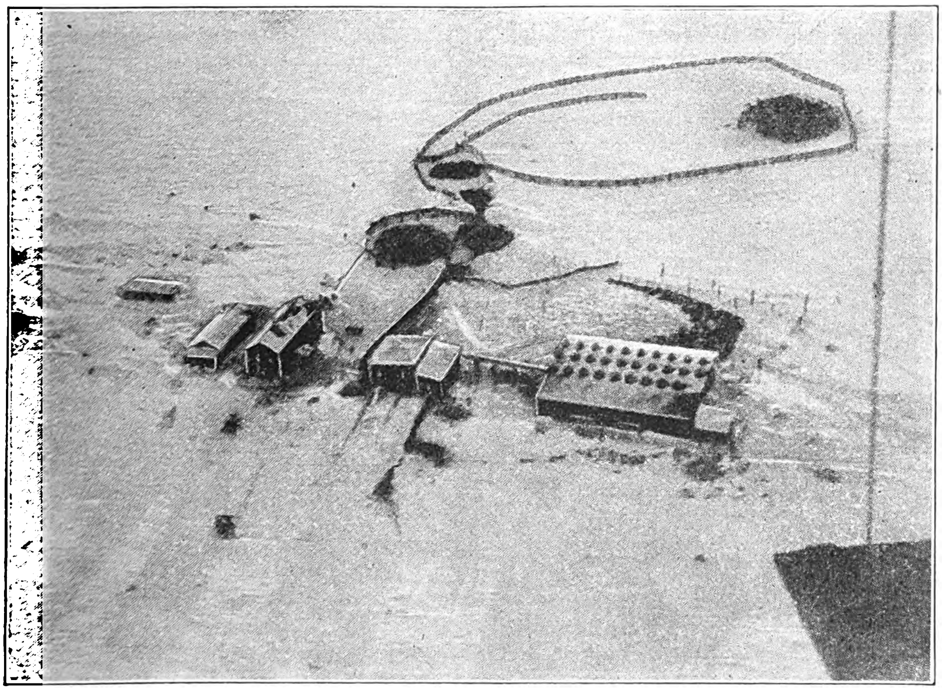
The reindeer is new to America, although old to Eurasia. It is in fact one of the oldest of the domesticated animals and is the most widely distributed mammal of the globe.

PACK REINDEER

Reindeer are occasionally used during the summer and have played a part in the development of Alaska by making it possible for prospectors and others to transfer supplies to remote sections

THE habitat of the reindeer circles the polar region and extends as far south as 52 degrees north latitude in Asia and to 53 degrees north latitude in North America—the island of Umnak of the Aleutian group. In Europe the southern limit is more to the north due to the influence of the Gulf Stream.

The reindeer is of the *Cervidae* family, the genus *rangifer* and the species *rangifer tarandus*. It differs from the ordinary deer in the particular that both the male and the female have antlers, which are shed annually.



ARCTIC STOCK YARDS

Reindeer are rounded up on the range and brought to the corrals on the coast where the steers are separated and the meat prepared under modern methods in sanitary abattoirs

Reindeer are gregarious. They flock together like sheep, but graze like cattle. In intelligence and activity they more nearly resemble the horse, being more intelligent than cattle. In spite of the dangerous appearance their large spread of antlers give them, they are the most docile of domesticated animals, and, except during the mating season—September and October—little children might safely play in a corral containing thousands of reindeer.

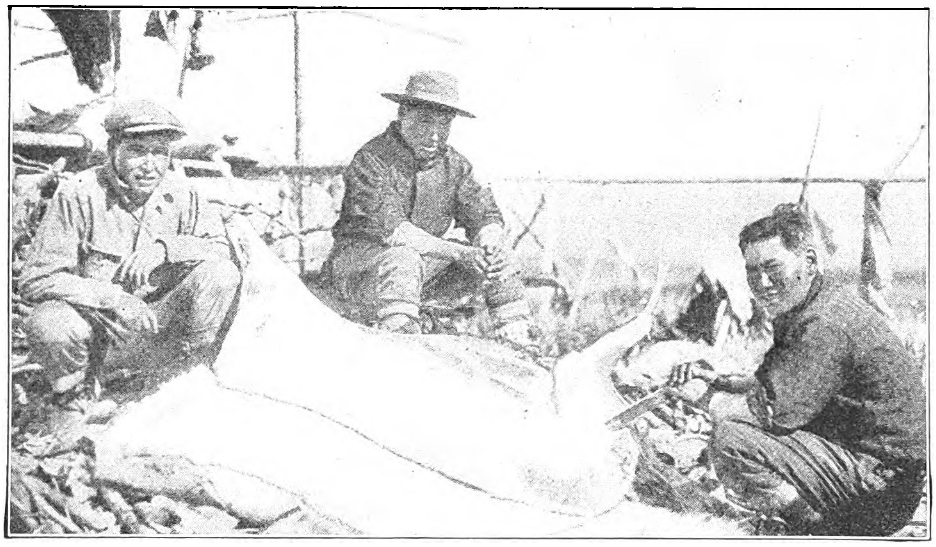
A reindeer "pasture" usually covers hundreds of square miles, and preferably contains highlands with winter feed and lowlands with the more luxurious summer vegetation, the area between constituting spring and fall ranges. The entire range is bounded by natural boundaries, rivers, mountain ranges, and sea coast.

The reindeer prefer the highlands to the costal plains and range inland the greater part of the year. The warm weather of early summer, July and August, combined with the activity of the arctic mosquito, forces the herds out of the hills to the sea coast where they are less molested and find comfort in the cooling waters of the ocean. The reindeer owners take advantage of this natural annual migration, and the marking and counting of the herds are performed during this season of the year.

One of Lapland's philosophers is Johan Turi, author and sage. Writing of the reindeer he says:

"THE reindeer were created before man, and man was created simply to look after them and follow them wherever they go and support himself by them. In his own estimation, a man is much wiser than the reindeer, but in spite of that, he must trudge along behind the reindeer wherever they wish to go. It is quite reasonable that the reindeer ought to do what man thinks; but man has not the sense to do it just the way the reindeer thinks. Man assumes that he is looking after the reindeer, whereas the reindeer probably thinks he is looking after man."

Unlike most animals, the reindeer prefers to travel against the wind. Heavy hair about his head and shoulders are special protection against cold. So sure are the herders of this animal instinct that during the severe blizzards which often sweep over the country they can seek cabin shelter for themselves for days and still be able to calculate the exact direction and the approximate distance to the point where they can find their herds when



MEAT FOR CAMP

Eskimos skinning a carcass, for camp use, taken from the natural cold storage at Igloo Point, near Kotzebue Sound, Alaska. Note whiteness of fat and its even distribution

the storm has passed over the range.

The typical reindeer of Alaska is dark brown in color, although the herds contain many white and spotted animals.

The reindeer are not particularly prolific. The doe gives birth to one fawn each year—rarely two. Strong and early fawn sometimes breed the first year.

The reindeer pastures during the summer on tender grasses, sedge, willow buds, mushrooms, and blueberries. During the winter they subsist entirely upon the lichens (reindeer moss). It is the most particular of all domestic animals in the selection of its food, and is particularly free from diseases. The Federal Government recently issued a circular letter on the status of reindeer meat, "For the information of state and municipal health officers, state conservation commissioners, fish and game commissions, and for the information of the general public," which reads in part:—

"REINDEER are not included in the federal meat inspection act, but reindeer meat may be received into the United States and be shipped interstate, and when marked for identification may be received and handled as such in federally inspected plants. It may also be used in the preparation of United States inspected and passed meat and meat-food products when such articles are appropriately labeled.

"The government has maintained experimental stations in Alaska and keeps in touch with the main herds of reindeer. No contagious disease has ever been encountered and no reason has appeared why the sale or use of reindeer meat should require federal, state, or municipal health inspection for the detection of disease...... The reindeer has for many centuries been a domesticated animal and therefore is in no way subject to game laws."

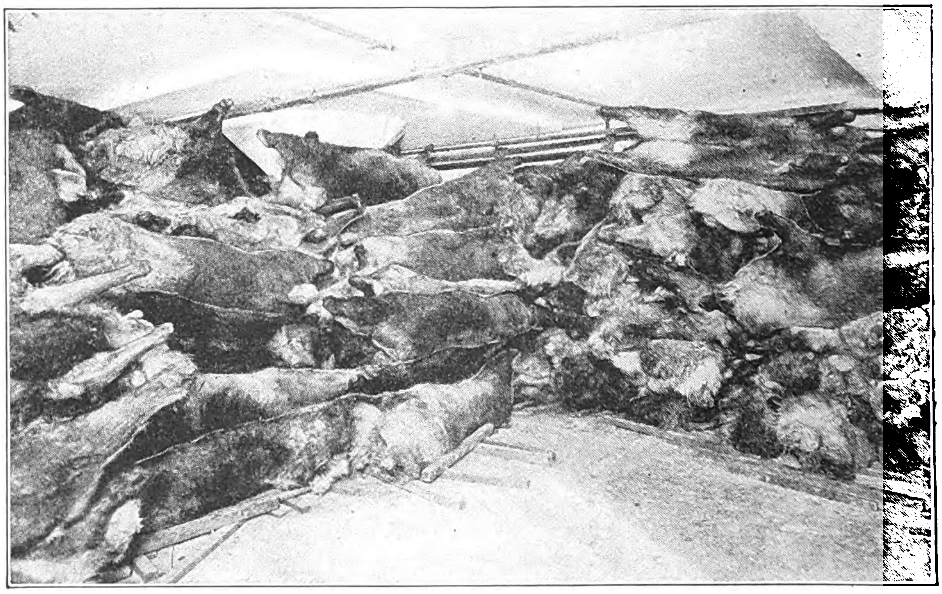
The perennial ice plays another important part in the industry in that it makes possible the construction of natural storage places for meat. One large plant has been constructed at Elephant Point on Kotzebue Sound with a capacity of 10,000 carcasses of meat. A tunnel is run into the frozen hillside and a series of rooms chiselled out in a manner similar to a hallway with rooms on each side, except that the partitions of frozen earth and ice are six to eight feet in thickness. Several cold storage doors are placed between the entrance of the tunnel and the rooms, and doors are placed in the entrance to each room. Ventilation is secured by means of double pipes driven through the roof, one just penetrating the ceiling at one end and the other reaching close to the floor at the opposite end of the room, which gives a free circulation of air. With open air temperatures ranging from 55 degrees below zero, Fahrenheit, to 90 degrees above, the temperature of these rooms varies from 15 degrees to 22 degrees, Fahrenheit, and keeps the meat in perfect condition.

When the full carrying capacity of the northern ranges of Alaska has been reached—probably in less than one generation—there will be available annually for market animals in number equal to the natural increase of the herds, or something in excess of one and a half million. This would represent approximately two hundred million pounds. Two hundred million pounds of meat would require a train of refrigerator cars more than 125 miles in length for distribution throughout the United States. While these figures seem staggering, they represent but little more than a pound and a half per annum for each inhabitant of the United States.

THIS industry is of national importance. The cattle supply of the United States is not equal to the demand. This condition will gradually become more serious. The importation of meat into the United States is necessary now to insure consumers even a moderate meat ration.

North of the cattle belt are grazing lands tremendous in extent. The reindeer is the only domesticated animal which can feed itself from those lands, the year 'round, and can live without shelter. The reindeer will, at the same time, make possible a permanent population over wide areas of the northern country which would otherwise remain uninhabited.

The American people may well be proud of the reindeer industry. It is Alaska's most original contribution to the commerce of the world and is likely to remain one of her greatest.



MEAT IN STORAGE, SEATTLE

Reindeer meat is brought to Seattle, Washington, from Alaska in ships equipped with refrigeration. Here it is held pending shipment to markets of the United States and Europe

OUR POINT OF VIEW

A Nocturnal Menace

ONE can hardly imagine a more ludicrous sight than that of a lumbering elephant carrying equipment developed for, and peculiarly adapted to, speedy automobiles. Yet in Ceylon, automobile owners are urging the authorities to protect them from the trains of merchandise-carrying elephants by providing the huge beasts with head-lights and tail-lights. It is said that these animals are practically invisible at dusk or even under the glare of the automobile lights and, therefore, are the cause of many serious accidents.

While the menace of unlighted pachyderms is a problem of Oriental countries, the United States has its problem in the darkly-clothed and careless nocturnal pedestrian on country roads. It would be a difficult proposition, indeed, to attempt to force such people to carry lights but they could be taught to exercise certain precautions. They should learn that it is dangerous not only to themselves to walk on the right side of the road but also to the motorist who approaches from the rear. Because of the neutral color of the pedestrian's clothes, the driver of a car cannot see him until only a short distance away; and in the event that the driver is blinded by the headlights of an approaching car, the pedestrian is not likely to be seen at all. The result may be a wreck that is disastrous to all. On the other hand, if the pedestrian is walking on the left side of the road, facing traffic, he can see approaching cars and can quickly step aside if a motorist does not see him or is blinded by lights from another car.

Man Versus the Insect

REITERATION of the pessimistic prophecy that man will, in time, be conquered by hordes of insects, often puzzles the layman. "There was a time," he will argue, "when a handful of human beings on earth held their own not only against insects but also ferocious beasts. Why then, with his infinitely greater numbers, his superior knowledge of combative methods, of poisons, and of the insects themselves, can he not effectively control insect pests at present?"

Before man had colonized much of the earth, a natural balance was maintained by living things. While the upsetting of this balance by the destruction of certain natural enemies of insects—notably, the birds—has much to do with the question, man's economic problems are more pointedly involved. To meet the necessity for food or the whims of taste, he now brings goods in ships from far corners of the world. And in those shipments, undesirable aliens, in the form of insect pests the ravages of which have hitherto been limited to certain localities, are brought in unwittingly. In his former abode, perhaps the immigrant insect was kept down by an enemy insect but in his new home is troubled by no such natural foe. Consequently, he thrives.

To our shores have come such devastating pests as the Japanese beetle and the European corn borer; and now the Mediterranean fruit fly, long dreaded and carefully guarded against, has made his appearance in Florida. Its presence there has resulted in a quarantine for certain sections of the state and, if it spreads, will mean perhaps a quarantine for the entire state. Already, Congress has appropriated 4,250,000 dollars with which to fight this migrant.

While we do not subscribe to the pessimism of those who foresee man's enslavement by the insects, we do realize the magnitude of the problem that confronts the nation. The Department of Agriculture spares no expense or effort in finding ways and means of combating our native and alien insect pests, but the co-operation of the individual is absolutely necessary. Only by strict observation of quarantines and adherence to the Department's regulatory measures will the nation be able to control these destroying creatures.

Snake Bite

THE recent death of Charles E. Snyder, head keeper of the New York Zoological Gardens, from the bite of a rattlesnake, evoked an avalanche of letters to the press relative to snake bite remedies. Some endeavored to show proof in support of the myth that whisky is an efficacious remedy. The majority, however, took the opposite view, and with good reason—note the remarks of a famous herpetologist on page 134 of this issue.

"The important thing to do when bitten by a venomous snake," says Dr. Daniel Davenport, F.Z.S., who was bitten by a cobra while on an expedition to Africa, and survived, "is to keep calm. Don't suck the wound as a fatal amount of poison may be absorbed by the mucous membranes. Don't drink whisky. If location of the bite allows, place a tourniquet between the wound and the heart. After 15 minutes, release the pressure for 20 seconds, then re-apply pressure, and repeat for an hour, gradually increasing the blood flow to one half, then a full minute." This is excellent advice.

Persons going into regions infested with poisonous snakes should carry with them a supply of anti-venin, the scientific and most certain of all remedies, which is issued under license by the United States Public Health Service and is obtainable at drug stores. If this is not available, a 10-cent box of potassium permanganate should be carried. Long recognized as a powerful remedy for snake bite when rubbed into the wound in crystal form or in solution, the permanganate may be purchased at any drug store.

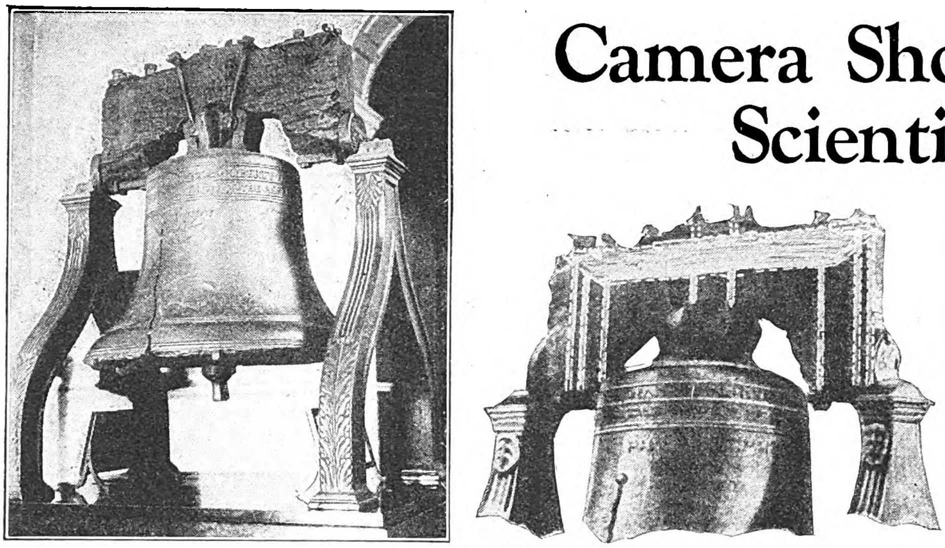
Guilty Cities

IN the atmosphere over New York City there is a floating mass of dust and dirt amounting to 2200 tons daily, according to an estimate of Professor H. H. Sheldon, of New York University, who has just made a laboratory analysis of the air for the Smoke Nuisance Committee. In other cities the condition is even worse.

Smoke accounts for much of the pollution of city air, and methods of combating it have been worked out in detail. But how many cities consider the incidental causes of this pollution? Or, having considered it, have rigidly enforced corrective measures? In city streets we have often seen great open trucks speeding along loaded with ashes, a veritable pall of ashes swirling behind them because those ashes were not covered as they should have been. We have seen men load these trucks carelessly so that great clouds of ashes were swept into the streets to be caught in the rush of traffic and scattered broadcast.

Why is this lax system tolerated? Complaints are often made but seem always to be pigeon-holed. Is it that municipal authorities are so bound up with red tape that such *minor* matters never get farther than the third assistant secretary to the secretary of the Man-of-Action? It is up to someone to get next to that last named person, whatever his title may be—to show him the situation as it is and point out to him how he can remedy it, to some degree at least, by the use of covered refuse trucks similar to those described in the SCIENTIFIC AMERICAN Digest of this issue.

Camera Shots of Scientific Events

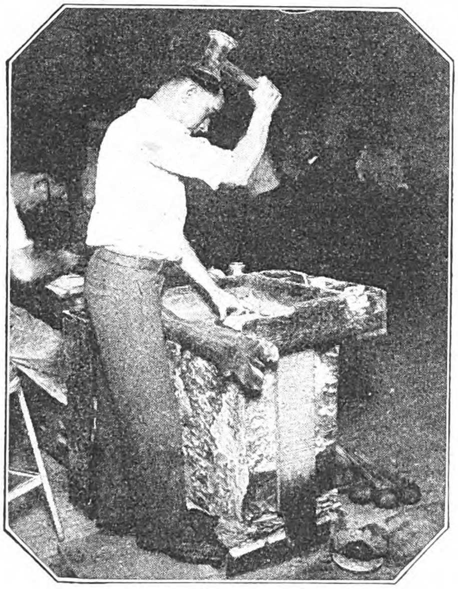


ITS ORIGINAL YOKE IS SAVED

The 176-year old timber yoke of the Liberty Bell seemed doomed. Dry rot had attacked it. Franklin Institute engineers suggested reinforcing it. Now it is no longer in danger, for steel capable of supporting 10,000 pounds has been inserted in the wood (the bell weighs just over a ton). At left is the bell as it appears today, the reinforcing in the old yoke being invisible; at right, a phantom of the reinforcing

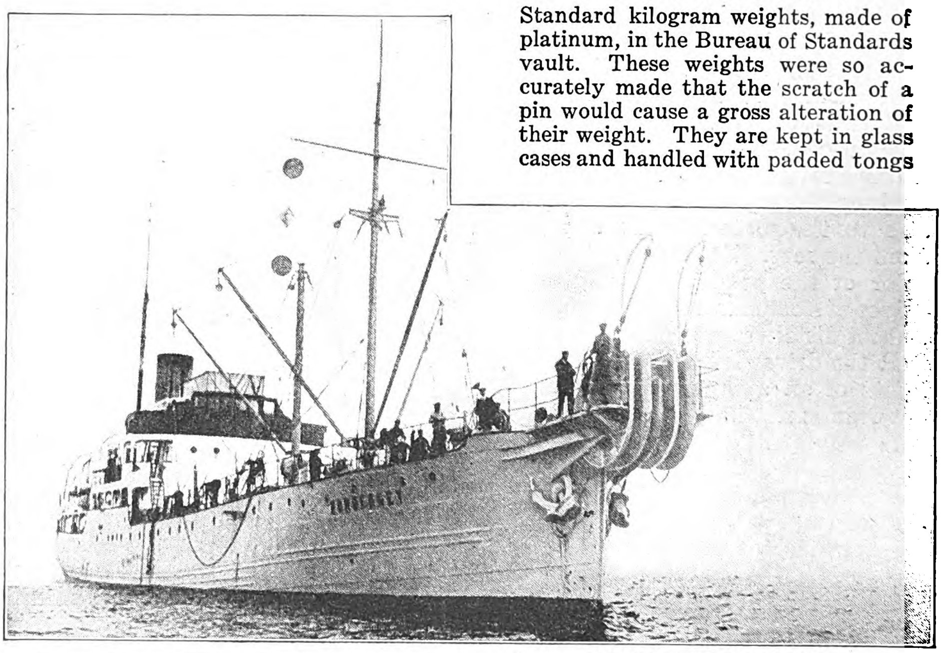
HANDLE WITH CARE

Standard kilogram weights, made of platinum, in the Bureau of Standards vault. These weights were so accurately made that the scratch of a pin would cause a gross alteration of their weight. They are kept in glass cases and handled with padded tongs



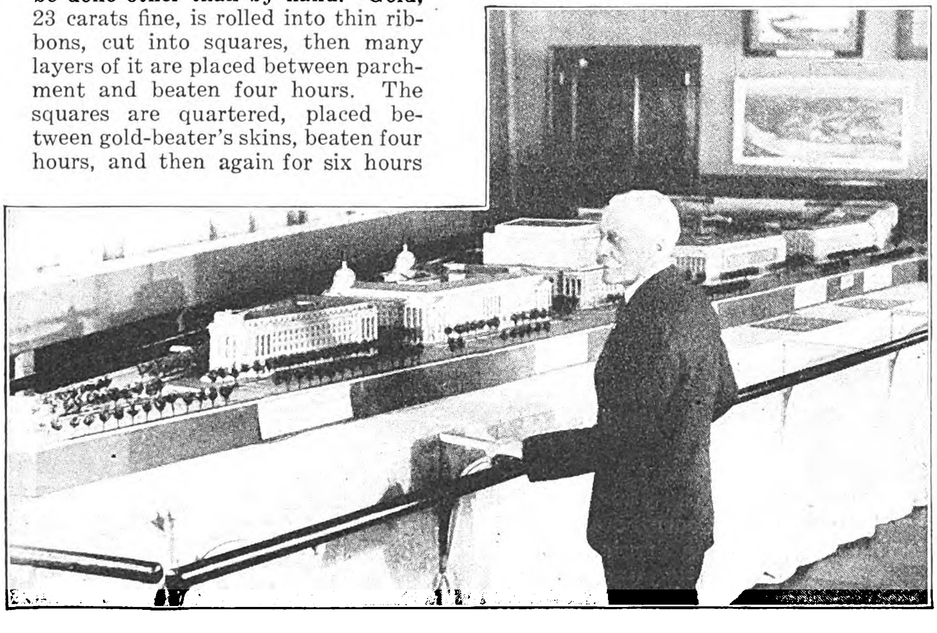
AS IN OLDEN TIMES

Gold beating is an art that can not be done other than by hand. Gold, 23 carats fine, is rolled into thin ribbons, cut into squares, then many layers of it are placed between parchment and beaten four hours. The squares are quartered, placed between gold-beater's skins, beaten four hours, and then again for six hours



▲ SHIP'S PROBOSCIS?

After five months of arduous labor, the laying of a new cable between Norrtelje, Sweden, and Abo, Finland, was recently completed. In some places the cable was laid at a depth of 780 feet. A feature of this system of through long distance cables is that nine conversations can be carried on at one time. The photograph shows the cable-laying ship, *Norderney*, with which the job was accomplished. One of the peculiar cable runways, overhanging the ship's bow, is shown

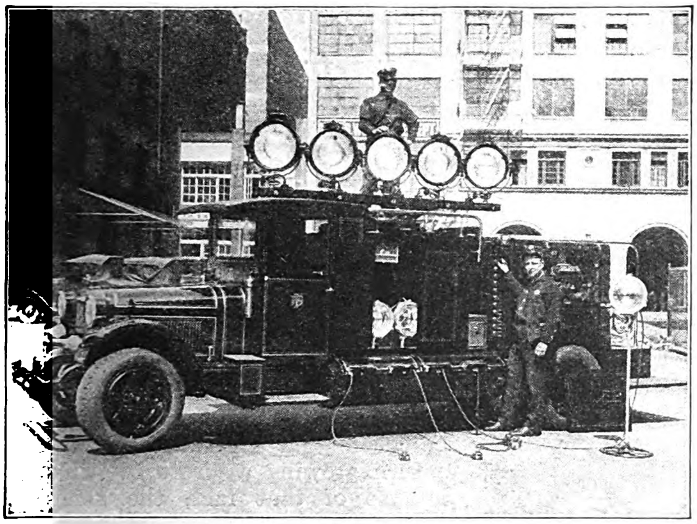


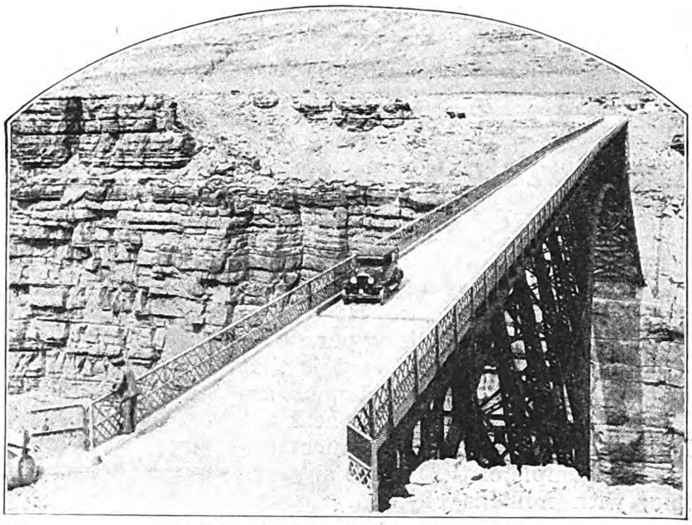
◄ BEAUTIFYING WASHINGTON

Approved and supported by President Hoover, plans to make Washington the city beautiful with the addition of new buildings are well on the road to realization. Mr. Hoover and Mr. Mellon recently viewed the models of the new buildings exhibited in the building of the United States Chamber of Commerce

SEARCHLIGHTS FOR FIRE FIGHTERS ▼

Built in San Francisco from designs by Sam Birmingham, of the Board of Public Works, this traveling electric plant went into fire department service in that city recently. A 10-kilowatt generator provides current for five 1000-watt searchlights and eight 400-watt lights on cables for use in fighting fires



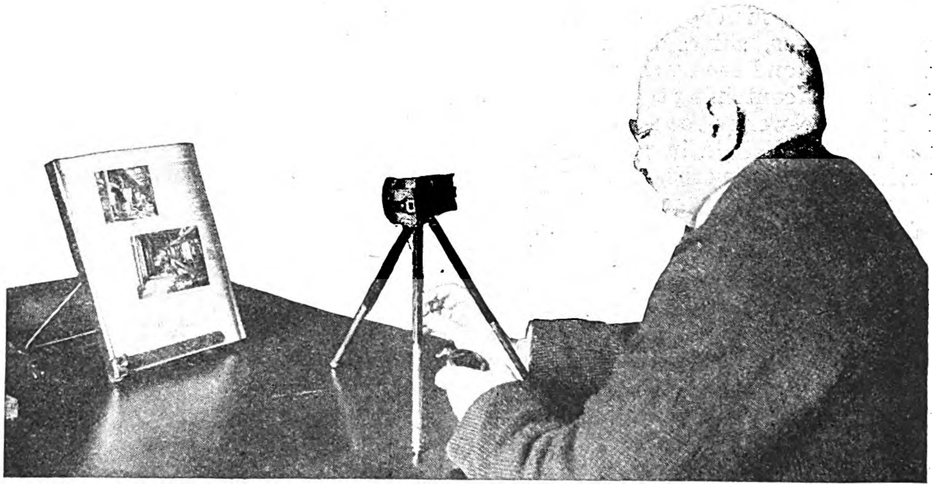


NEW AUTOMOBILE ROUTE

The Hamblin-Hastelle Bridge, as the span over the Grand Canyon at Lee's Ferry is now known, was dedicated in June in a celebration in which officials of both Arizona and Utah participated. The 834-foot concrete floor of this bridge provides a connecting motor highway link between the states

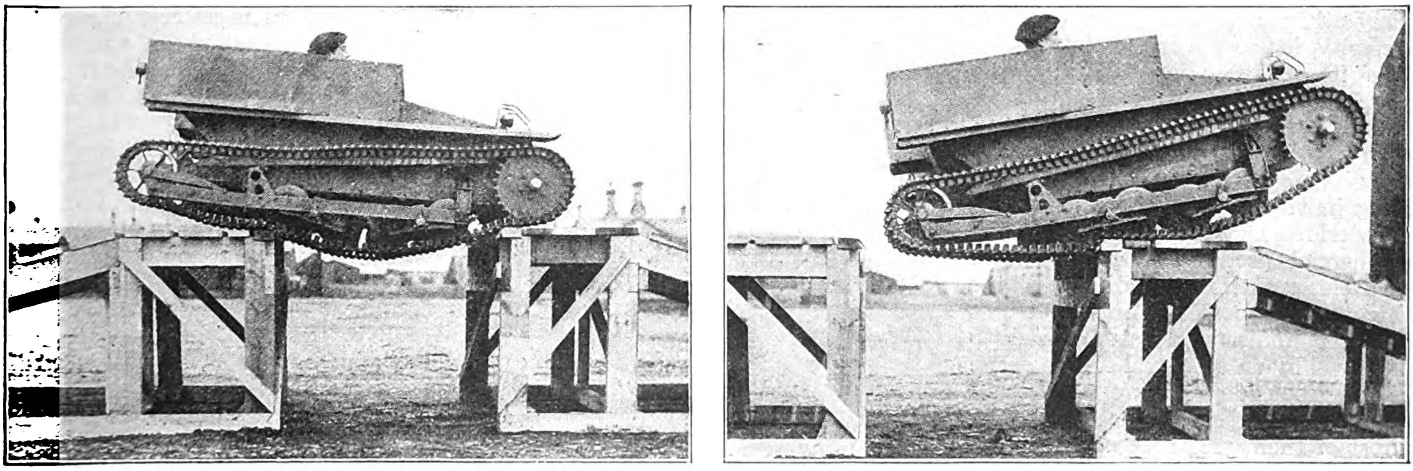
FROM A MOVING TRAIN

The Canadian National Railways recently inaugurated a telephone-from-train service on one of its fast trains so that passengers may talk to any point on the continent while the train is moving. Here Mr. W. D. Robb, vice president of the road, is shown talking from a moving train



VALUABLE BOOKS

Practically every big library has among its collection a number of precious books of which there exists but a single copy. Naturally there is great risk when these are loaned. To prevent this, the Berlin State Library is using a special apparatus to photograph every page of such books. When the photographs are enlarged, the books may be read in the reproduction so that wear of the original is prevented



A JACK RABBIT OF THE BRITISH ARMY

Since the World War, great progress has been made in the design of fighting tanks. They are speedier, have greater maneuverability, and are capable of making long runs without an overhaul. Engines, treads, and armor have been improved, and the whole has been balanced so well that the machines can cross such "trenches" as the wooden one here. A tank of the Third Battalion, Royal Tank Corps, British Army, rehearses for the Royal Tournament

Diatoms

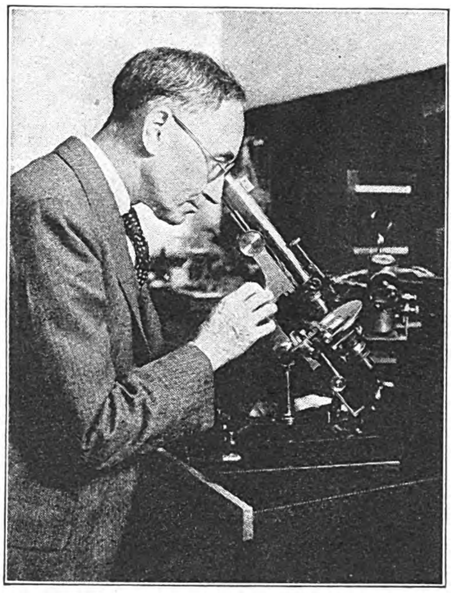
These Lowly Microscopic Forms of Life Provide a Fascinating Hobby for the Amateur Scientist, but Their Industrial Uses Give Them Immense Economic Significance

BY HAROLD McFADDEN

ONE of the surprising paradoxes of this world of ours is that the things we use the most are often the things we hear the least about. Probably the most apparent example of that is the automobile; with millions of them running around, only about one person in a thousand has any idea of what makes the wheels go 'round, or why it goes faster when you step on the gas.

Of that class is the diatom which, although forming the very foundations of commerce, is scarcely known by the general public to be in existence. Yet the average man polishes his teeth with diatoms, shines his automobile with them, and then washes his hands with a soap containing the same things. He rides to work over smooth asphalt roads that are held in place by these invisible things, works in a huge concrete office building that required tons of them in the construction work, and then eats his lunch on a composition table top containing them. He pays for his lunch check, which probably is printed on a paper containing them, returns home at night after buying gasoline and oil that has been filtered through them and spends the evening in his home, which has been insulated and sound proofed with them—all the while never dreaming that he ever has consciously seen, felt, smelled, or heard of such a thing as a diatom.

PROBABLY the main reason for that is because the diatom is virtually invisible to the naked eye. Like many other articles of general use and necessity, it needs a microscope to disclose its nature. The diatom is a microscopic plant—one of the most abundant of all living things—a body of protoplasm encased in the honeycomb-like cells of a silica shell, and living in the fresh and sea waters of the world. Diatomaceous earth, the commercial product, is composed of the skeleton shells of the diatom plants which were deposited on the bottoms of water bodies and later raised to land level by an upheaval of some sort. Diatomaceous deposits are found in all lands of the earth, but the largest and purest of them are those of California and adjoining Pacific coast states.

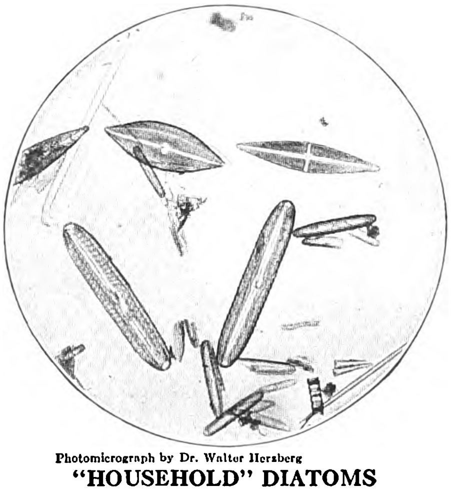


LOOKING AT DIATOMS

Dr. Walter Herzberg, who makes the study of diatomaceous earth a hobby and an avocation, using a powerful microscope

First described in 1703 and 1704 in papers of the Royal Society, although known previous to that, there followed a period of more than 200 years in which famed scientists of the world argued whether to class them as animals or plants. Because of the fact that they had characteristics of both families, neither the botanists nor the zoologists wanted to claim them. As a result, the poor little diatom remained an orphan until early in this century when the discovery that chlorophyll was its coloring matter definitely established that it was a plant, and therefore botanical.

The orphan diatoms received a baptismal name about 1805. The microscope was far from perfection in those days and as a result, about all the scientists could see of them was that they were very small, and that each one grew double, having two sides held together with a band or girdle, much after the manner of a pill box with a removable top and bottom. They learned that the reproductive process consisted of the two halves casting off the girdle and separating, each half in turn growing a girdle of its own. Because of that fact, the scientific men of the early nineteenth century named the plants diatoms, referring to the fact that they divide longitudinally (Greek *dia tomeo,* to cut through), and not, as has been asserted by some naïve individuals, because they might be said to resemble "two atoms" (the word is accented on the "di" and the "di" rhymes with "eye." The last syllable is exactly like the name Tom).



Photomicrograph by Dr. Walter Herzberg

"HOUSEHOLD" DIATOMS

White's Polishing Cream contains these forms as a mild scouring agent. Note their variety. There are many other forms

Until now there have been discovered about 8000 different kinds of diatoms composing 150 families, and new varieties are being located continually.

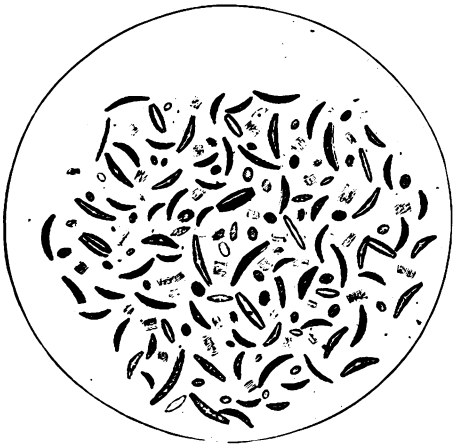
HOWEVER, the complexity of the diatom forms need be no barrier to the layman who desires to find them for himself. There are a number of very low priced microscopes that will reveal to him not only the diatom, but also another world of things, the very existence of which he has not even dreamed. A student-type microscope with a power of magnification from 50 to 150 diameters is sufficient for the beginner and, if desired, an additional eyepiece may be obtained later that will increase its power to 250 diameters.

Diatoms are of two general types, fresh-water and marine, and seem to require only light and water to thrive. They are found alive in fresh, brackish, and sea water, but never in water that abounds with putrefaction, or water of extreme salinity such as the Salton Sea or the Great Salt Lake. Neither will they live in pure or non-aerated water; and yet, in Yellowstone Park they apparently thrive in some pools that have a high arsenic content. They are found in the pack ice water of the arctic, at a temperature of about 30 degrees, Fahrenheit, and in the pools at Hot Springs, West Virginia, where the temperature is 126 degrees. Altitude seems to be no barrier to their growth as they have been collected in the Alps by the side of a melting ice formation at an altitude of 12,000 feet.

Therefore, it will be seen that anyone desiring to find his own diatoms will have no trouble in locating sources of supply that will keep him busy for many years on new varieties. In most cases it will not even be necessary to leave one's own home. Where the water supply is obtained from storage reservoirs, lakes, or rivers, a plentiful supply can be obtained directly from the tap. They will not be found, however, in water that is pumped from deep wells or springs.

THE method is simple. Tie a cambric handkerchief over the mouth of the faucet and allow the water to run softly for about one half hour. Carefully untie the handkerchief and swish that part which has acted as a filter in a vial of distilled water. Place a drop of this water on a microscope glass slide and on it lay a cover glass. Set the microscope at 100 diameters and have a good light, but not too bright, focused underneath the slide. It is best to locate the organisms first with the low power and then raise the instrument to a higher power for closer examination. As some of the organisms in the drop of water will be transparent and almost invisible in white light it is well to own an inexpensive color filter.

The student will have some trouble at first in differentiating between diatoms, desmids, infusoria, and other forms of minute life, but after a little study and with the aid of a text book* on the microscope a fair degree of proficiency will be obtained. Close observation and a good memory for details are the chief stock of the expert microscopist.



AFTER CLEANSING

The same lot shown in the upper illustration sorted out and magnified about 75 diameters. Their beauty is most striking

The student also will find a myriad of diatom forms by scraping the surface of leaves, stones, and sticks found along the edge of ponds, lakes, and rivers. The scrapings are put into vials of distilled water and the operation with the microscope is the same as described with tap water. The tiny plants also may be obtained by squeezing the water from algae or green slime found along the edges of slow running streams or in ponds.

Skeleton forms of diatoms or diatomaceous earth deposits present a greater difficulty for the amateur to locate, having little outward indication of being different from a chalk or limestone deposit. However, if the student succeeds in locating one deposit of the earth, others will be fairly easy to recognize.

As with the higher species of life, there are diatoms which favor certain temperatures to the exclusion of others, but the majority seem to favor the cooler water, and the species of the arctic regions are 10 times as numerous as those of the tropics. The reproduction interval is shorter in cooler temperatures; in the arctic it is from three to six hours and in the tropics from 20 to 24 hours.

RAISING diatoms is an easy business. Some painstaking scientist figured that if you started off with one diatom of a class that had a habit of dividing into two every 10 hours, in 30 days you would have, theoretically, one thousand million, or, to make it look bigger, 1,000,000,000. Another good example of the abundance of the plants is to be found in tests made on the North Pacific Ocean off the Island of Unimac. A quart of water taken there was estimated to contain 7,850,000 diatoms. Five or six million to the quart are more or less common in the seas north of 60 degrees north latitude, while in the waters south of 60 degrees south latitude, with the temperatures identical with those of the north, the count seldom runs to more than one half million to the quart.

About this time the layman usually asks, "What good are diatoms?" and "What do they look like to the naked eye?" To answer the first question hundreds of scientists have devoted their lifetime to the study of the mysterious plants; in fact it was primarily because of the desire to learn the internal structure of the diatom that the microscope was brought to its present state of perfection.

However, with our present knowledge, the microscope has reached its limit of power, yet microscopists are far from knowing the complicated internal structure of the diatom—a silica shell of such intricate construction that the most powerful microscope leaves intimate detail to imagination. The second question easily is answered. When alive in water, a single plant is invisible to the naked eye, but enough of them will add color to the water. The shells or skeletons of the dead plants (diatomaceous earth) appear very much like lumps of chalk, very light in weight.

MISCELLANEOUS DIATOMS

Before being cleaned and classified, a sample may look like this when studied

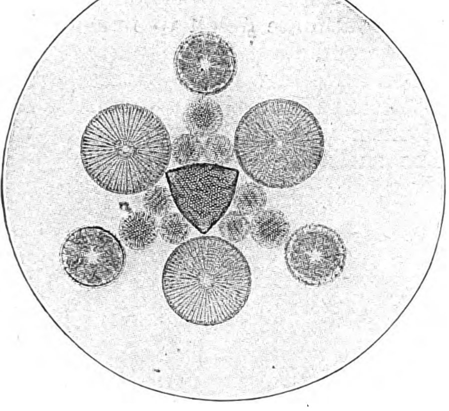
The first actual use of diatomaceous earth on record was by the Romans in 522 A.D. in making what were termed "swimming bricks." Emperor Justinian ordered the dome of the Church of Santa Sophia built of that material in order to lighten the weight of the structure. The first commercial use of diatomaceous earth in the United States was in 1865, in the manufacture of Zozodont tooth powder. The diatoms were taken from a fresh-water deposit in Beddington, Maine. The next use of importance was in 1873 when a metal polish, Wright's Silver Cream, was first manufactured from a fresh-water deposit at Keene, New Hampshire.

IN 1888, the deposits in Nevada were opened and the material was shipped to England. Some of it came back to us in the form of Electro-Silicon and Silver White, both metal polishes. The remainder of the diatomaceous earth sent to England was used for the absorption of liquid manure. That is the first record of the use of the western deposits, and also the first foreign shipment of the material.

When, a few years later, the California deposits were put to use, scientists had found applications for the material which required gross quantities, in comparison with the tooth powder business where a carload would stock the manufacturer for a year. Probably the most common use is admixture with cement, to make the mixture flow more easily when poured and to give it a smooth surface free

---

*For the beginner the most suitable book is Plaskitt's "Microscopic Fresh Water Life," as it contains practical instructions. Other books are: Needham and Lloyd, "Life of Inland Waters"; Shipley's "Hunting Under the Microscope," and Ward and Whipple's "Fresh Water Biology." On the microscope itself, see Gage, "The Microscope." If enough direct requests are received, more articles on microscopic fresh water life will be published later. Its observation is a fascinating hobby.—The Editor.



Photomicrograph by Dr. Walter Herzberg

ARTIFICIALLY ARRANGED

A group from various parts of the world. Diatoms have worldwide distribution

from air pockets. The diatom in the cement mix also makes it more durable, aids materially in preventing excessive shrinkage, and speeds the setting process.

With the demand for diatomaceous earth in huge quantities came hundreds of unforeseen difficulties in mining and preparation of the material. The chief value of the diatom is in its sieve-like structure. It is of almost pure silica, but that alone is of little unusual value. Therefore it was logical that the common practice of grinding non-metallic minerals would not be of value for diatoms, for the very apparent reason that the grinding would destroy the plant shells and the resultant product would be merely a finely powdered silica.

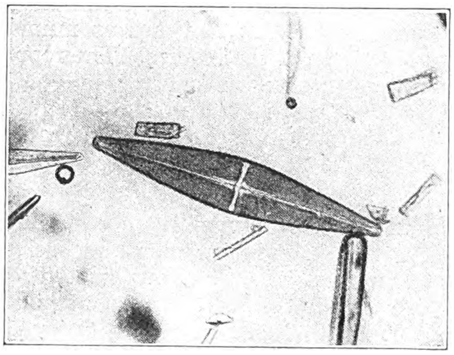
MILLIONS of dollars were spent in the development of suitable machinery for breaking up the bulk material and sorting it according to size and purity. More than one group of business men in California have learned to their sorrow that the diatom seems to be guided at times by the "imp of the perverse." Hundreds of companies have been formed in the western states for exploiting diatoms, but less than a dozen have survived.

An example of the perverseness of the plant shells is the problem of sorting the material after it is broken up. Most ordinary non-metallic minerals can be segregated to size by means of screens of various size mesh. However, the diatom refuses to be screened. If you doubt that, take a handful of the material, which looks much like fine clay, place it on a 200 mesh screen and shake it. After a great amount of physical exertion, you will have about a tablespoon full of diatoms which passed through the screen and the remainder will be clinging as tenaciously as molasses to the wire mesh. Diatoms are, however, easily separated by several other methods. The chief one is by air blast.

This quality of interlocking, also of porosity, makes the diatomaceous earth one of the most valuable filtration materials. It is probable that more research has been done with diatoms for that purpose than any other, for here it has a broad application and the research work has been done in an effort to establish the proper degree of fineness suitable for the most desirable particle structure to prevent sliming and compacting in filter presses.

In the sugar and oil industries diatomaceous earth finds almost universal application. There has been a most noticeable advance in the clarity of extracted vegetable oils through its proper use. It is used extensively in the filtration of wines, beers, syrups, and in fact almost everything where filtration is practiced. As diatoms are of many different geometric shapes and sizes, according to locality, the secret of an application in filtration work is merely that of the selection of the proper kind of diatom for the work to be performed.

One of the most recent uses to which the diatom has been put is that of mixing with asphalt paving material to prevent the sun from drawing the solvents to the surface and causing a softening which results in a "washboard" or rolling surface. The natural locking properties also act to hold the material itself in place.



DIATOMS IN COMMERCE

If you have used Zozodont tooth powder you have used millions of these diatoms

Another extensive use of diatomaceous earth is as a thermal insulator. Because of its porous nature and small point of contact, diatom upon diatom, it has a very low thermal conductivity, while the silica of its composition has a very high melting point—about 1950 degrees, Fahrenheit. Thus it is used as brick-tile pipe covering, thermal cement, loosely granular as a jacket for steam boilers, high temperature ovens, cookers, furnaces, annealing pits, refractory brick, evaporators, and stills. For low-temperature insulation, it is used in cold storage and refrigeration plants and as a filler for ice boxes and coolers. Because of the same physical properties that make the material valuable as an insulator, it is applicable as a sound-proofing material in the floors and walls of buildings and, as such, is now used.

Other uses include that of a filler in the manufacture of paper, a base for several brands of fire-resisting paint, and as a filler in a number of scouring and hand soaps. Its abrasive qualities are very mild and for that reason, many polishing powders for use in delicate jewelry work are made from it. Formerly it was used as the abrasive in matches and as a filler in dynamite, but those two uses have been replaced with more adaptable substances. The material also finds use in the absorption of waste liquids in various processes and stages of manufacturing.

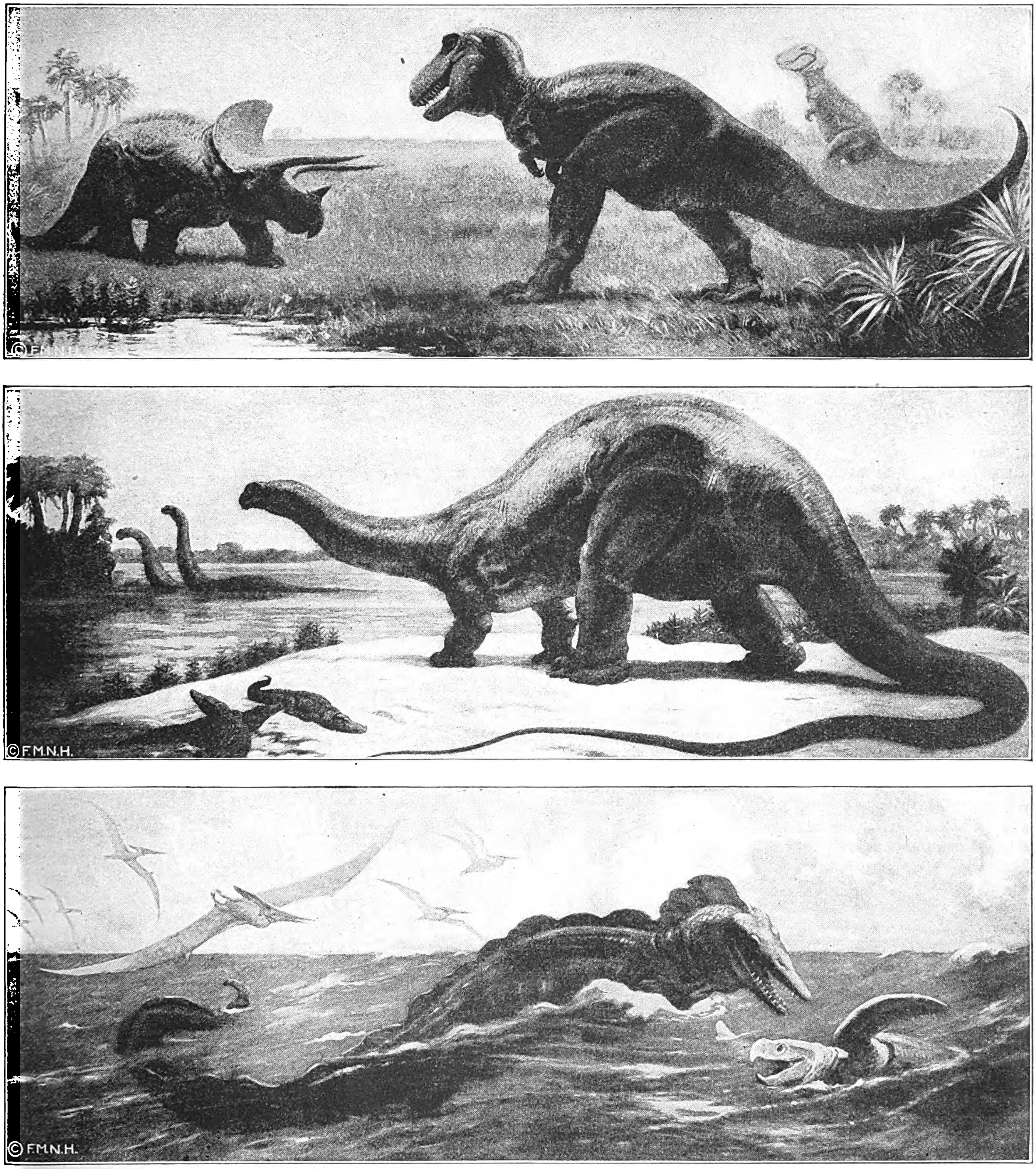
RECENTLY a clay tile and pottery plant brought out some unusual finishes in its products by using diatomaceous earth in the glazing material. The surface of the materials, while as hard as other glazes, had the appearance and "feel" of soft kid leather.

In the United States important deposits of diatomaceous earth are found in California, New York, Virginia, and Maryland; and to a lesser extent in Connecticut, Massachusetts, Florida, Nevada, and Washington. The annual output in the United States is above a million dollars. Europe is plentifully supplied by its own deposits, but the world demand is said to be growing and the discovery of new uses is not unlikely.

The uses of the mysterious little diatom are legion and probably within the next 10 years its adaptability will be increased. Each day brings new uses and improved applications of old ones. One of the strange things about the many applications of the material is that a great number of them have been made by men who knew little or nothing of the physical nature of the diatom; some indeed, did not even know of the existence of the diatom plants and carried on their experiments thinking they merely were working with a new kind of non-metallic mineral.

MAGNIFIED 4400 TIMES

Cross-section of diatoms in asphalt mixture, showing how they bind the material together, which is their function


©F.M.N.H.
©F.M.N.H.
©F.M.N.H.

Giant Inhabitants of Our Continent, More Than 100,000,000 Years Ago

THE ancient dinosaurs are a never-ending source of fascination to scientist and layman alike. This may be partly due to their great bulk—although we have today a much larger living animal, the whale. But is not the chief reason the fact that the dinosaurs are extinct, and therefore that we have never seen them? In fact no human being, not even primitive man, has ever seen a dinosaur, for there is no evidence that a single one of them survived past the end of the Cretaceous Period, nearly 100,000,000 years ago. Just why the dinosaurs became extinct is still a puzzle. Several theories are listed in textbooks of geology, the most intriguing one being that the small, rapidly evolving mammals of that time—remote ancestors, incidentally, to man—destroyed their eggs. The dinosaurs depicted above were painted by the scientific artist Charles R. Knight. The length of the original paintings, which are now permanently attached to the walls of the Graham Hall of Historical Geology at the great Field Museum of Natural History, in Chicago, is 25 feet. The upper painting shows the mammoth tyrannosaurus (right) about to engage in a duel with the only contemporaneous creature capable of giving him a worthy battle, the triceratops. The middle picture shows the brontosaur, which was a vegetarian. Below is a mosasaur, a kind of predatory "sea-going" dinosaur 25 feet long; also a flock of pterodactyls, flying reptiles.

GOODYEAR
AKRON

A MODERN POST-WAR SMALL BLIMP

The *Puritan*, a late American design. Her sister ship, the *Pilgrim*, has made more than 500 trips in a year and a half on a single filling of helium. An interesting story is told that the British, during the war, classed such ships as "B" limp; hence the present name "blimp"

The 'Old Rubber Cow:' The Blimp

Non-rigid Scouting and Observation Dirigible of War-time Is Slow but Sure; It Has Great Commercial Possibilities

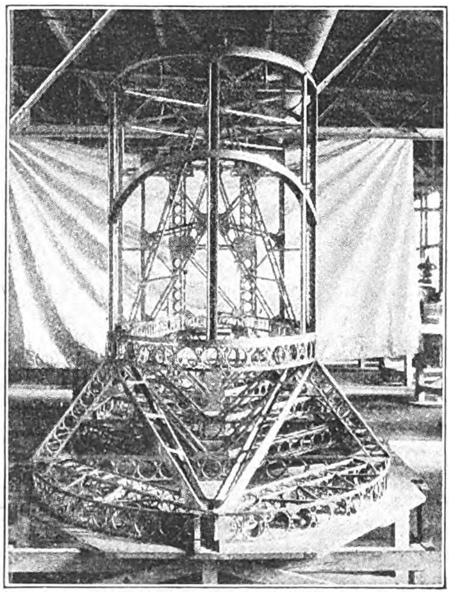
By JOHN T. ROWLAND

THE small dirigibles which were used for scouting and observation purposes, and especially those employed in the coastal patrol, made a war record as extraordinary as it is little known. Duty done, they faded from sight and mind. Today you will occasionally see a blimp exercising itself above a British, French, Italian, or American naval base; but the breed is rare. It has been eclipsed on the one hand by the airplane, and on the other by the huge rigid dirigible which is the only lighter-than-air ship to have received great attention from civilian minds.

THIS is extraordinary in view of the proven superiority of the blimp for certain kinds of work. Perhaps to some people it is a new idea that it can ever be more advantageous to move slowly, rather than fast, so we shall adduce a few concrete cases; for

(1) aerial photography and map making; for
(2) meteorological observations aloft, over a period of time; for
(3) timber cruising to estimate stand of sound timber, percentage burnt over, et cetera. This calls for close and unhurried scrutiny; for
(4) forest rangers' patrol on lookout for fires; and for
(5) exploration.

The list might be indefinitely extended, because it would contain every sort of travel where the thing that counts is observation rather than speed. And the point is that the airplane *cannot* go slowly; its very life depends upon high speed. Skillful pilots offset this disability to some extent, but until they can cut off power and soar for long periods, their planes will not equal the blimp in this respect, and even then they will not succeed in hovering motionless over a given spot or in drifting with a favoring wind. In these two achievements the lighter-than-air craft stands unique, and in the very nature of things must always do so. Its advantage at times may be very great.



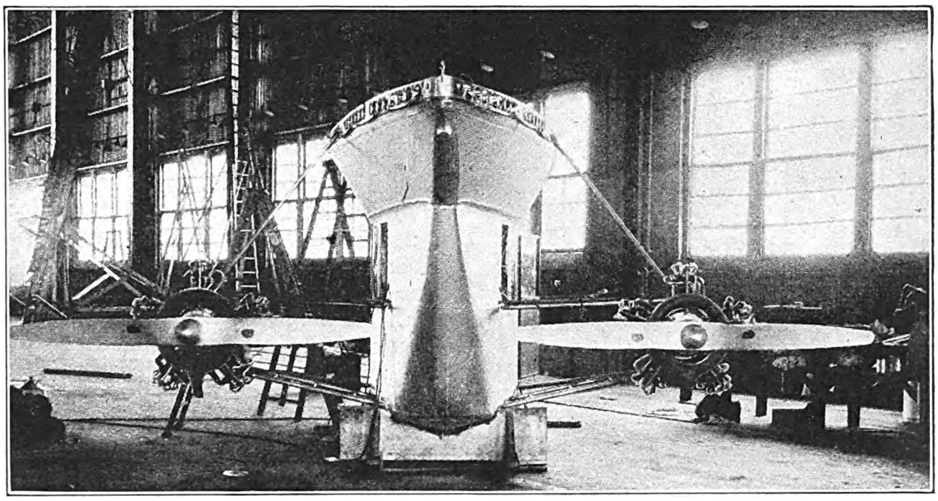
BLIMP CABIN FRAME

This view of the cabin, or gondola, of a blimp (upside down) shows structure

A notion prevails that the blimp (by which we mean the small non-rigid dirigible) is an awkward, unwieldy, and uncertain ship to handle, particularly in high winds. This idea proceeds from sheer ignorance of the facts; the records of the British Naval Air Service show surprising evidence the other way. For example: Coastal blimp number 9 was inflated at her base in Cornwall on July 1, 1916, and was not deflated until September, 1918. She remained in commission for two years and two months, and during that period spent 2500 hours in the air, or an average of three hours per day.

AT the same station there were only eight days without air patrol between the months of January and November, 1918. This was a particularly stormy winter and spring; no clumsy or un-airworthy ship could have survived it, yet it was nothing unusual to see blimps maneuvering in perfect comfort when our destroyers were laboring in a heavy sea. I remember thinking that the blimps patrolling the south coast of Ireland took a great chance of being blown offshore and lost at sea in the heavy gales which frequently blew from the northwest. One day we saw one coming towards us, and stood by to rescue her. But when she had come within a hundred yards or so, she nosed up into the wind and lay there while one of her crew semaphored a message to us. Then she headed back inshore—and went there far more comfortably than we were able to follow in the destroyer.

Another and more cogent objection has to do with the difficulty of housing a blimp. A larger hangar is required than for a plane, and it is difficult to get a blimp into or out of a hangar when the wind is wrong. But natural shelter, such as that offered by hills and woods, is a great help; and it has been found entirely practical to house the smaller blimps in a clearing cut out of the heart of a fairly dense woods, without any building at all. Still, it must be admitted that this is a problem not yet completely solved.



TWIN-MOTOR POWERED

Rear view of completed cabin of a modern blimp, showing the two air-cooled motors which drive "pusher" propellers. It will be noted that motors are accessible for minor repairs

BUT the most serious objection to all lighter-than-air craft is the practice of inflating them with hydrogen, one of the most inflammable of gases. To this source may be attributed some of the worst accidents in recent years. It is a quite needless hazard. The natural gas produced by nature's hand in certain parts of this country contains, along with other ingredients, the rare helium gas which is only a trifle heavier than hydrogen and is absolutely non-explosive. It is the ideal substance for the inflation of dirigibles, both large and small. Helium is recovered from natural gas by a rather costly process of liquefaction and regenerative distillation.

Experts who have studied the problem state that great economies may be effected as soon as there is a sufficient demand for helium to warrant its commercial recovery on a larger scale. It is not, however, the initial cost that counts so much as the loss of gas from the evelope and the necessity of replenishing it. This loss occurs mainly in two ways: (1) by leakage through the fabric and (2) by "valving," or permitting the gas to escape. Improvements in the fabric have made it so nearly gas tight that item (1) is almost negligible save for long periods of time, but valving is unfortunately a necessity incident to the maneuvering of a ship under conditions which frequently arise.

What happens is that the gas with which the envelope is filled at a given condition of temperature and atmospheric pressure, expands rapidly when its temperature increases due to the sun's heat, or when the ship has risen to an altitude where the pressure of the surrounding air is less. In all modern airships the envelope is provided with an expansion chamber to take up this increase in volume of the gas. This chamber may be simply a portion of the envelope, separated from the gas-filled portion by a fabric diaphragm, or it may be a sort of fabric bottle lying within the envelope and communicating with the outer air by a pipe. In either case the chamber is kept filled with air at a pressure slightly in excess of atmospheric, which is maintained by an air scoop or a fan and serves to keep the envelope snugly inflated. When the gas expands, this chamber correspondingly shrinks and the pressure within the envelope as a whole remains unchanged. The difficulty comes when the expansion is more than can be taken care of in this way. Since the envelope is not designed to withstand great internal pressure, the pilot must then open his escape valve and let some of the gas out in order to avoid disaster.

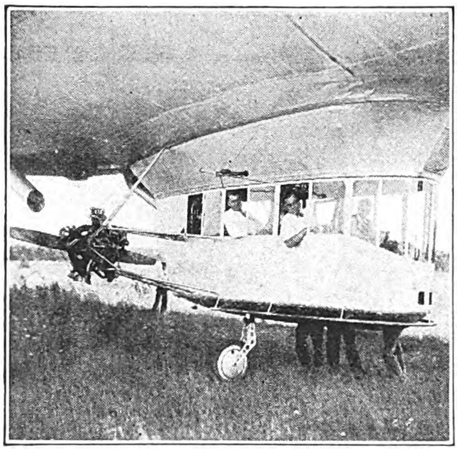
FIRST TO BE FILLED WITH HELIUM

United States non-rigid dirigible *C-7*. Airships of this general type were dubbed "Old Rubber Cows" by war-time flyers, a nickname originally applied to "sausage" balloons

Still another troublesome factor enters in. When the gas has expanded sufficiently to occupy most of the space formerly taken up by air, it follows that the buoyancy of the ship is increased, and she will tend to rise. If the pilot cannot overcome this by "nosing down" she will go higher and higher until he valves off gas and allows her to descend.

IN the big rigids an extremely ingenious device has been developed to get the best of this danger by collecting water vapor from the atmosphere. This overcomes the too-great buoyancy of the ship and brings her down to the desired level. The apparatus is rather cumbersome for a small blimp, but perhaps some modification may be devised. It also compensates for the loss of weight through expenditure of fuel.

It will occur to the reader that these difficulties are of a nature susceptible to conquest by further experiment and study. Too much credit cannot be given the army and navy fliers who have devoted their efforts to this task, as well as to a very few private individuals



A "PARKED" BLIMP

Note the caster landing wheel and the air scoops for maintaining full bag inflation

and firms. Foremost among the latter is the Goodyear Zeppelin Company, of Akron, Ohio, which has made some notable advances both in the manufacture of the fabric and in the design and construction of the ship. Their experimental "pony blimp," *Puritan*, which cruised east to New York this past autumn, demonstrated what the smallest non-rigid can do. This little ship, 128 feet long by 37 feet diameter, with a gas capacity of only 86,000 cubic feet, has a useful lift of 1132 pounds and a range of 340 miles at 46 miles per hour on one filling of the tanks. Her maximum speed is 56 miles per hour. She is powered with two five-cylinder radial air-cooled motors, developing 70 horsepower each. As at present arranged, she carries 332 pounds of gas and oil, which leaves a capacity of 800 pounds to be divided among pilot, passengers, and goods. She has an enclosed cabin and can be handled by one man.

THIS type of ship has a tremendous advantage over the plane in every sort of work where it is necessary to come close to or maintain contact with the ground. Even when a landing might be impracticable, due to strong winds, the blimp can come down low and hover, heading into the wind and turning over her propellers fast enough to remain motionless in air. In this situation she may quite easily discharge or receive packages, messages, and even passengers, using a lowering line or rope ladder (in the latter case) for the purpose. Crashed aviators have been rescued by blimps from places where a plane could not possibly land.

As an adjunct to the airplane the blimp should fill a useful role in the postal service by collecting the mails in remote districts where there are no railroads and where planes cannot land. To the Geological Survey and the Coast and Geodetic Survey, the use of small blimps to maintain contact with parties in isolated and inaccessible locations might well prove a great saver of time and funds. Weeks and even months are consumed merely to reach mountain peaks where no airplane would dare come down, and yet where a blimp could negotiate a landing with comparative ease. If this is true of certain government services it applies equally well to commercial enterprises faced with similar problems of exploration and communication. In all such activities, and even in such diverse fields as sheep ranching and commercial fisheries, the blimp's ability to go slowly and observe, will one day find its use.

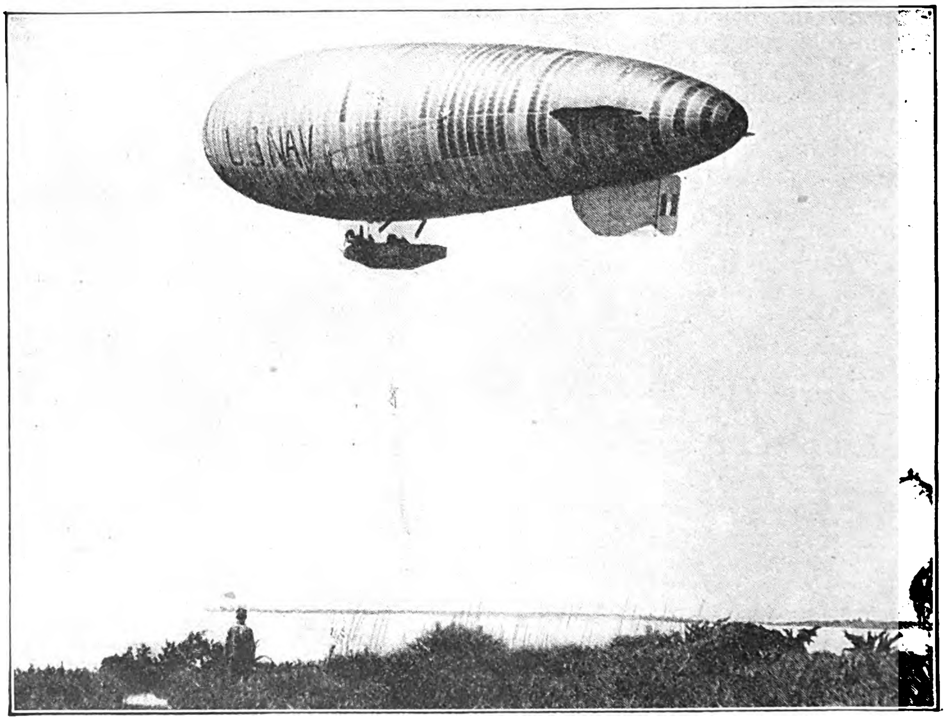
There is also the safety factor to be considered, for the blimp, inflated with helium, cannot explode and it need never crash. Owing to the fact that it is small and has no rigid frame it is in no danger of buckling or bursting from internal stress. At a pinch it can land anywhere, without regard to topography or space, and while it may, if not housed, be subsequently blown away and destroyed, the crew will at least have an excellent chance to escape. Its slower speed makes it less likely than the plane to run into a mountainside in the fog, and even if it does so the danger to life and limb is tremendously less.

ONE of the early blimps collided at full speed with the side of a tall building in New York, bounced off and proceeded on its way! And even though the blimp should stop dead in the air it will not slip or spin. Lightning and the risk of being blown out to sea or into the wilderness without sufficient fuel appear to be the only serious dangers it must face.

To those who saw the British naval blimps on patrol day after day in all kinds of weather, skimming the surface, hovering motionless to mark the location of a sunken ship, or flying high in the blue against a wild westerly gale, the statement that they are not "practical" is no less than absurd. What more severe practical test could be devised than they met then? If they could do those things 10 years ago, they can do others today which would be useful in times of peace.

A SMALL craft capable of carrying three persons 340 miles through the atmosphere at a sustained speed of 46 miles per hour, of drifting with a fair wind or bucking a head wind, of remaining motionless above a given spot for purposes of observation or communication, of rising and descending in a very small space and, finally, of landing or taking off on terrain where an airplane would be wrecked, has potentialities not to be dismissed lightly.

We Americans are a headstrong race of speed worshipers, yet we must admit that it would be folly to hitch a race horse to a plow. Similarly, travel and commercial transportation does not always mean getting to a destination in the shortest possible time. The airplane is a frantic, rocket-like sort of conveyance, marvelous for rapid transit but admittedly lacking in repose. Where it fails, the blimp excels, and vice versa. It really seems as if the two were designed to supplement each other, but man so far has been singularly blind to the uses of one —the slow but sure "Old Rubber Cow."



AN OLD-TIMER MAKES A RESCUE

By means of a hanging rope ladder, an aviator is picked up from terrain where it is impossible to land an airplane to effect a rescue. To do this, the blimp did not have to land

What the World Owes to South Africa

Not Only the Fruits and Grains and Flowering Plants, But the Birds and the Mammals, Including Man Himself, Are Believed to Have Evolved in South Africa

By R. BROOM, M.D., D.Sc.
Fellow of the Royal Society
Late Professor of Geology and Zoology at Victoria College, Stellenbosch, South Africa

MOST people consider that the world is indebted to South Africa only for diamonds and gold, but I wish to show that the debt it owes is far greater. Not only was South Africa the home of the origin of all the higher animals and plants, but there is good reason to believe that it may also have been the home of the first man.

At the end of the Coal Period the whole world had only primitive types of animals and plants. In both the northern and southern hemispheres the only land animals were large and small salamander-like forms, and the plants were mainly gigantic horsetails and club-mosses, with ferns and what are called seed ferns, and a few primitive pine-like trees.

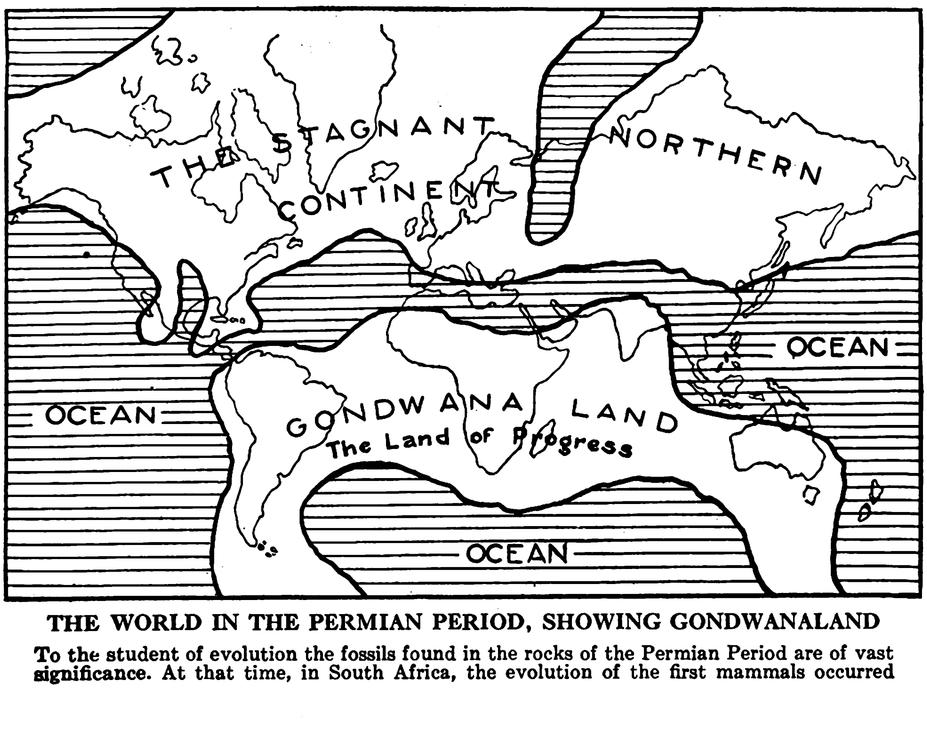
About this time the lands of the southern hemisphere became divided from those of the north by sea, and formed a huge continent which included most of what today is Africa, South America, and part of India and Australia. Doubtless most of the south Atlantic and the Indian Oceans were then land and also formed part of that continent. This great continent is called "Gondwanaland."

For a time much of Gondwanaland was covered by ice; but soon after the end of the Coal Period, temperate and even tropical conditions prevailed and new types of animals and plants began to make their appearance.

In South Africa we are fortunate in having a most wonderful record of the progress of evolution during the five or ten millions of years that followed the Coal Period. We have an uninterrupted succession of shales which by their fossils reveal to us better than in any other part of the world, the evolution of animals for long periods of time. Examining the layers of the shale is like turning over the pages of a book of history. The lower layers show us the life of the earlier times—the upper layers, as deposited, of the later.

Whence the Mammal?

IN the accompanying article Dr. Broom writes of one of the most fascinating and significant phases of earth history, the ancient times when warm-blooded mammals, including our own direct ancestors, were evolving from the reptiles. Readers who wish to pursue this subject further will find much information in Lull's "Organic Evolution;" also in Osborn's "Origin and Evolution of Life." Pirsson and Schuchert's "Textbook of Geology" is also recommended.—*The Editor.*



THE WORLD IN THE PERMIAN PERIOD, SHOWING GONDWANALAND

To the student of evolution the fossils found in the rocks of the Permian Period are of vast significance. At that time, in South Africa, the evolution of the first mammals occurred

The lower shales are not very rich in animal life, but are interesting in showing us a peculiar little fresh water, lizard-like animal which also inhabited Brazil.

A little later we find a very rich fauna with the huge pareiasaurs—those hippopotamus-like reptiles familiar to all students of geology from the figures in the textbooks, and with the pareiasaurs were large carnivorous reptiles that doubtless preyed upon them. Some of these carnivorous types were 15 feet in length.

With these large reptiles were others much smaller, and interesting not only in being much like the warm blooded mammals of today but in being, there can be no doubt, the ancestors of the higher forms of today. Many of these mammal-like reptiles had teeth arranged like the teeth of the dog, with large eye-teeth, and they had the same number of joints in their fingers and toes that man has today. They walked about with their bodies off the ground and no longer crawled like the salamanders, and there is reason to believe that it was this change of habit that started the evolution which resulted in the warm-blooded mammals. The scaly skin became soft and the scales developed into hairs; and the increased activity that became possible gave rise to the higher forms.

In the shales of South Africa we have hundreds of different mammal-like reptiles—primitive types in the lower beds, and in the upper layers the remains of animals so like the mammals of today that it is not always possible to be quite sure whether they were cold blooded or warm like true mammals.

THE shales not only give us the history of the evolution of the mammals, but show us the stages in the development of the lizards and crocodiles. They also have revealed to us how the dinosaurs arose, and have given us some clues to the origin of birds. When the beds have been more fully studied we will probably have all the steps we could desire in the evolution of these many higher types of life.

The interesting point is that in

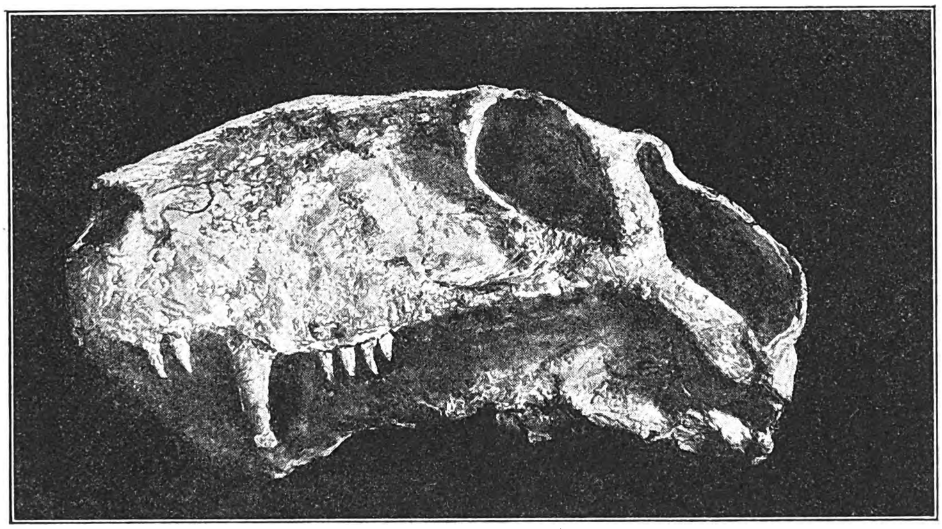
Gondwanaland there was a wonderful blossoming of higher types of life, and this at a time when there was little or no evolution taking place in the north. During the whole of the Permian Period—that is for some millions of years after the close of the Coal Period—the old types of life continued in the north with only slight modifications, and in all the textbooks of geology the Permian Period will be found placed beside the Coal Period as part of the Paleozoic age or the "age of ancient life."

The Mesozoic age or "age of reptiles" begins, as is shown in the text books, with the next period, the Triassic. The reason for this is that in the Triassic we find appearing in the northern lands large numbers of new types of animals and plants. The whole northern hemisphere becomes transformed. The old forms die out and new forms suddenly take their places. One can almost forgive the early geologists for believing that the Triassic represented a new day in creation.

Of course it was no new creation. It was merely the result of a portion of the dividing sea becoming land and the new types of animals and plants that had been evolving in Gondwanaland overflowing into the northern lands and "civilizing" them. Almost all the wonderful new types of animals and plants that have been discovered in the Triassic rocks of the north are now known to be related to somewhat similar forms that lived many years before in Gondwanaland.

And then, Gondwanaland again became cut off from the north, and the north was left to do what it could with the southern animals and plants. For some millions of years during most of the age of reptiles—the Jurassic Period and much of the Cretaceous—there was no connection with the south. Crocodiles, dinosaurs, and turtles abounded, with a few primitive mammals and a very few birds. They were modified slightly, but not improved. The plants were mainly cycads or sago palms, maidenhair trees and primitive pines, but no flowering plants, and for thousands of years there was no progress.

Then suddenly, in the Cretaceous Period, a great change takes place. Flowering plants of great variety appear. Where they came from no one knows. Darwin years ago suggested that they had been evolving in the south and suddenly were admitted into the northern lands. There can be little doubt that that is what happened, although we cannot prove it. We do know that the flowering plants did not evolve in the north, and although we have no direct evidence, we are justified in concluding that the evolution of the flowering plants occurred in Gondwanaland.



SKULL OF ONE OF THE SOUTH AFRICAN MAMMAL-LIKE REPTILES

For the first time in known evolutionary history the teeth of these advanced types of reptiles had become specialized as molars, canines, and incisors. This was a significant step

When the new types came into the north there was again a complete revolution, and this time a far greater one than occurred in the Triassic. The clothing of the land with grass probably resulted in a great change in the composition of the atmosphere. In the Cretaceous Period we seem to find in all animal groups evidence of some great struggle. The dinosaurs that during the Jurassic and early Cretaceous times were gracefully built animals, begin in the upper or later Cretaceous Period to take on the most fantastic shapes. Great plates of bone developed around the heads of such forms as triceratops—plates too thin to have been of any use as means of defence. In some reptiles horns were developed; or large spines. Anyone wandering around the dinosaur collection of the American Museum in New York, or other large museums of natural history, will see some of the wonderful developments that took place during this period of struggle. Even the shells in the sea seem to have been affected. The ammonites became strangely coiled; some even became completely uncoiled. The oysters became enormously thickened.

But soon all the struggles appear to have been in vain. The dinosaurs die out and with them disappear the plesiorsaurs, the ichthyosaurs, and the pterodactyls. And in the sea, the ammonites disappear and are never again met with.

With the flowering plants from Gondwanaland there probably came into the northern lands new types of mammals. The few mammals that lived in the north before the middle Cretaceous Period were probably all egg-laying forms like the platypus of today. But with the flowering plants, there probably came into the north from Gondwanaland mammals of a higher type such as insectivores allied to the moles and shrews, and marsupials allied to the opossums.

And then at last Gondwanaland's work was nearly done. The north now was able to carry on the evolution. Most of the mammalian groups we have today evolved in the north—the cattle, the horses, dogs and cats, rabbits and mice, monkeys and bats.

And yet Africa may have rendered one other great service to the world. There is considerable reason to believe that Africa gave to the world its greatest prize—man.

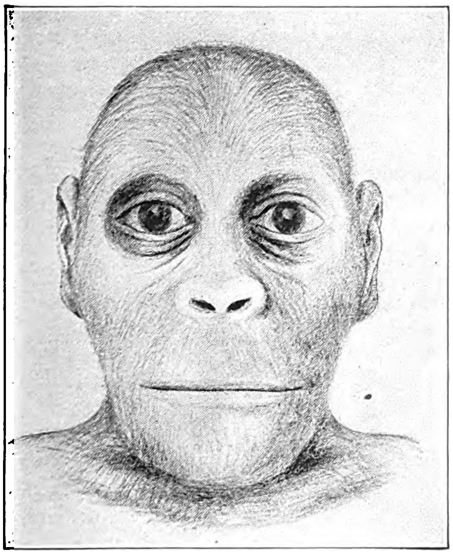
There has been great difference of opinion as to where man originated. Monboddo believed that man originated in Africa, and so did Darwin. The discovery of the ape-like man, *Pithecanthropus*, in Java swung opinion around in favor of Asia as having been the ancestral home. The discovery of the jaws of the anthropoid ape *Dryopithecus* in India seemed to confirm this view. To-day Osborn, Matthew, and many others are in favor of Asia as having been the ancestral home. Elliot Smith of London believes that Africa was probably the home, and I who live in South Africa am "patriotic" enough to side with Elliot Smith. In favor of Africa it must be admitted that the two anthropoid apes which come nearest to man, the chimpanzee and gorilla, are to-day living in Africa, and the only other living anthropoid apes which live in Asia, the orang and gibbon, are considerably farther removed from the human stem.

There is a point which is not usually accentuated as I think it ought to be, namely that, in man, the gorilla, and the chimpanzee there are only eight bones in the wrist, but in all the other apes there are nine. The gorilla and the chimpanzee have usually been regarded as somewhat removed from the human line through their more arboreal-like habits and their tendency to walk on all fours, resulting in a less man-like foot and a less erect attitude. It has long seemed to me that if we had a gorilla-like ape which had become less specialized for living in forests but had taken to living among the rocks or on the plains and running more on its hind feet, we would have all we could desire as a starting point for man. And just three years ago such a form was discovered in South Africa.

Professor Dart in 1925 startled the world by his announcement of the discovery of the skull of a small man-like ape which he called *Australopithecus.* The skull was found fossilised in a lime-stone cave at Taungs, near the western border of the Transvaal. The exact age of the deposit can not be determined. In my opinion it must be very old, probably either Pliocene or Pleistocene, but if Pleistocene, pretty certainly early Pleistocene.

The skull is that of a quite young animal, comparable in age to a human child of five or six years, and it is consequently a little difficult to restore completely his appearance as it probably would be in adult life. Dart has given a preliminary account of the discovery, one or two other scientists have also examined the skull, and some others who have not seen it, have given their opinions from the study of the casts.

It is admitted by all that the *Australopithecus* is allied to the chimpanzee, but there are many points in which it differs from the chimpanzee. The milk teeth differ entirely from those of the chimpanzee and gorilla, and agree very closely with those of man. The brain is of the human shape and shows certain very marked advances in the human direction, from the brain of the chimpanzee or gorilla. The bones of the temporal region are also much more like those of man than of either of the other anthropoids. Dart has shown further that the head must have been poised much more erect than the head of either the chimpanzee or gorilla, and thus that *Australopithecus* must have walked more erect. If he walked more erect he must almost certainly have been bipedal. I venture to prophesy that when the hind foot is discovered, it will show that it approaches the foot of man in a surprising way.



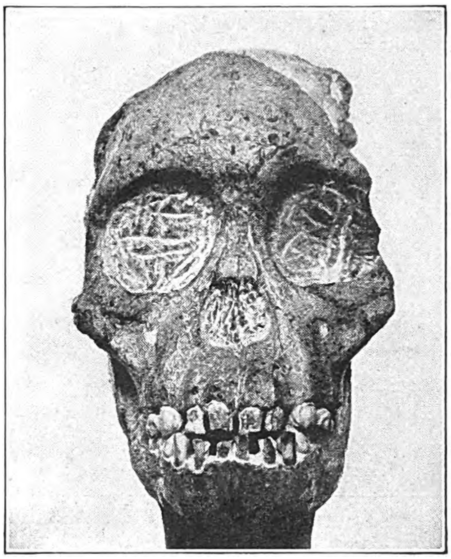
THE TAUNGS "CHILD" APE
An original restoration by the author. No living ape is so manlike as this one was

There is another most important point. Taungs to-day is in a very dry region, and among the rocks and open forest the only monkeys are baboons and little apes. Associated in the cave where *Australopithecus* was found, are numerous skulls of a species of baboon, sufficiently satisfactory evidence that the climatic conditions when *Australopithecus* lived were very similar to those of to-day, and we can be quite certain that *Australopithecus* was a rock-climbing, plains-living and not a forest-inhabiting animal.

Dart, with the intuition of genius, boldly made *Australopithecus* the type of a new family intermediate between the higher apes and man. This was perhaps a little daring on the evidence, and most of his critics have considered that in this he was wrong. But if when a good skeleton is discovered, as it probably will be in a very few years, it is seen that *Australopithecus* has a foot approaching the human foot, as I believe will be the case, Dart will be thoroughly justified in his conclusions.

ONE much prefers a scientist who will boldly show where he thinks the evidence leads than one who is too cautious to express any opinion. Hrdlicka, the eminent American anthropologist, recently visited South Africa and saw this wonderful skull. He says, "The skull itself is that of an anthropoid ape approaching rather closely in size and form the chimpanzee, but in all probability it is a new species, if not genus, of the great apes. . . . Just what the relation this form bears on the one hand to the human phylum, and on the other to the chimpanzee and gorilla, can only be properly determined after the specimen is well identified, for which are needed additional and adult specimens."

It is interesting to know that in all probability it is a new species. Any paleontologist of experience would have no hesitancy whatever in making it certainly a distinct genus and probably Dart is right in making it the type of a new family. Sollas has shown that the skull differs very greatly from that of the chimpanzee, and concludes that "*Australopithecus* makes a nearer approach to the Hominidae than any existing anthropoid ape." Surely science has advanced sufficiently far to enable one to determine something of the affinities of an anthropoid ape from a single but good skull of even a young individual. It will no doubt be of great importance to have an adult skull which will convince the world and even anthropologists.

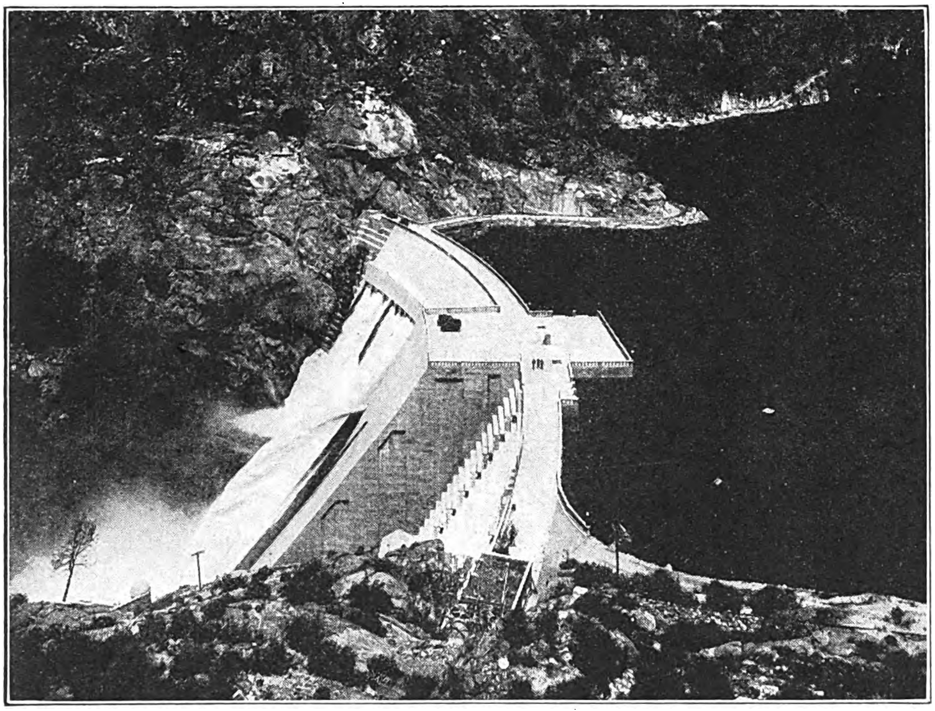


THE TAUNGS FOSSIL SKULL
Found in South Africa in 1925. This is one of the best preserved fossil skulls

One of the two figures which I give represents the front view of the skull as preserved and as most beautifully cleared by Professor Dart. The other is a restoration as the soft parts would appear after taking the bony framework and merely covering it with flesh. The only point in the restoration which is in the slightest doubt is the shape of the nose, of which we have no evidence. I have restored the nose in a form somewhat intermediate between that of a gorilla and chimpanzee. It will be seen that *Australopithecus* is a small human-like ape which no one need be ashamed of having as a forefather.

Certain anthropologists have maintained that *Australopithecus* could not have been a human ancestor because it lived at a time after mankind had probably appeared on the earth. Manifestly, as the specimen died when five or six years old, it could not have been the ancestor of any one, but there is no objection to considering this little specimen as a representative of a race which may have survived hundreds of thousands of years; and that one member of the same tribe, perhaps in early Pliocene times, may have been the ancestor of mankind.

If I am right in claiming that the world owes to South Africa its mammals and its birds, its flowering plants, its fruits and grains, its grass and its blossoms, its cotton and its hemp, and lastly man himself, then to no other country is its debt so great.



PART OF A CITY'S WATER SUPPLY

The O'Shaughnessy Dam as it is at present, creating a beautiful reservoir in a rocky canyon. A highway has been built on its crest; cars and people are visible near its center section

Novel Features of the O'Shaughnessy Dam

Inspection Galleries and Pre-cast Concrete Sections in Large Dam

By C. W. GEIGER

A DAM that will ultimately furnish 400,000,000 gallons of water daily to a community of 4,000,000 people—or 100 gallons daily per person—has just been completed in the Yosemite Valley in California. Named the O'Shaughnessy Dam after the man who built it, this dam is a unit of the gigantic Hetch-Hetchy project which is being developed by the city of San Francisco into one of the most modern water supply systems in the country.

The O'Shaughnessy Dam, as completed at present, rises 226 feet above the stream level but its foundation was designed to support an 86-foot addition which will make its ultimate height 312 feet and its length at crest 900 feet. The present crest is 3727 feet above sea level. The reservoir behind the dam has a capacity of 67 billion gallons of water but when the additional top section is constructed, it will have a capacity of 113 billion gallons, and will then supply daily the amount of water mentioned in the first paragraph. A hydro-electric plant, also to be constructed later, will generate power amounting to 200,000 horsepower for lighting and general industrial purposes.

There are many interesting features in connection with this dam, one of which is the inspection galleries. Interior stairways, leading to the stream-bed level from the top of the dam, are built into both ends. These stairways are connected by two cross-galleries, one at a point 41 feet below the crest and one at a point 225 feet below the crest. The stairways and galleries allow a thorough inspection of the interior of the dam at any time and give opportunity for observation of the action of the porous drains and contraction joints.

Interior galleries are built on the upstream face of the dam for operating the large slide gates and the 5-foot balanced valves. These galleries are reached through independent ladderways which were cast in the concrete as the structure was built up.

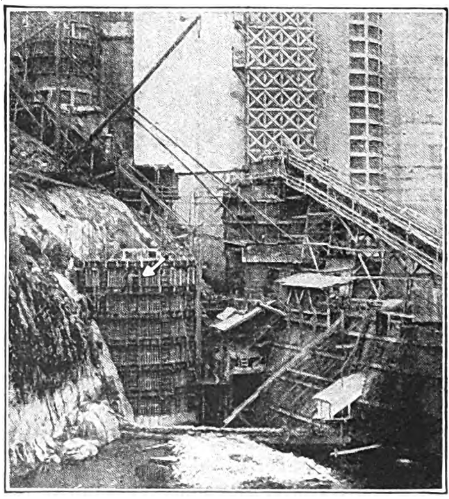
Ladder wells were formed on the contraction joints by forming each half of the well as a block in the block plant, and placing and fitting these on the plane of the joint slightly in advance of the concrete pouring. Porous concrete blocks 3 feet 3 inches square outside measurement and with a 15-inch square cavity, were cast in the block plant and placed near the upstream face, at 12-foot intervals, to form a drainage system.

Three screen racks guarding the entrances to the outlet conduits were built on the face of the dam. These consist of pre-cast reinforced concrete screens supported on reinforced concrete columns and ribs and ranging in height from 60 feet to 112 feet. The screen racks cover all of the openings leading to the valves and serve to prevent any debris reaching and lodging in the valves.

WATER stops made of 1/16-inch sheet copper are used to prevent seepage along the contraction joints. These pieces of copper were bent into a bellows shape and placed in the concrete in sections as the dam was built up, extending from the bottom of the structure to the top. Copper water stops were also placed along the top of the dam to seal the joints between the present crest of the dam and the future extension. The copper water stops have been subjected to the test of a full reservoir and no seepage past them has been observed.

The spillway of the dam consists of 18 siphons, each about 4 feet by 10 feet, and placed in three series at slightly different levels. The siphon openings were formed in the concrete as the structure was built and are heavily reinforced with steel. Each siphon has a capacity of approximately 1000 cubic feet per second. The water discharging from the siphons cataracts down the steps on the back of the dam and forms a waterfall of imposing appearance.

It is the plan, on the final completion of the dam to full height, to bypass the floods through canals and tunnels past one of the abutments of

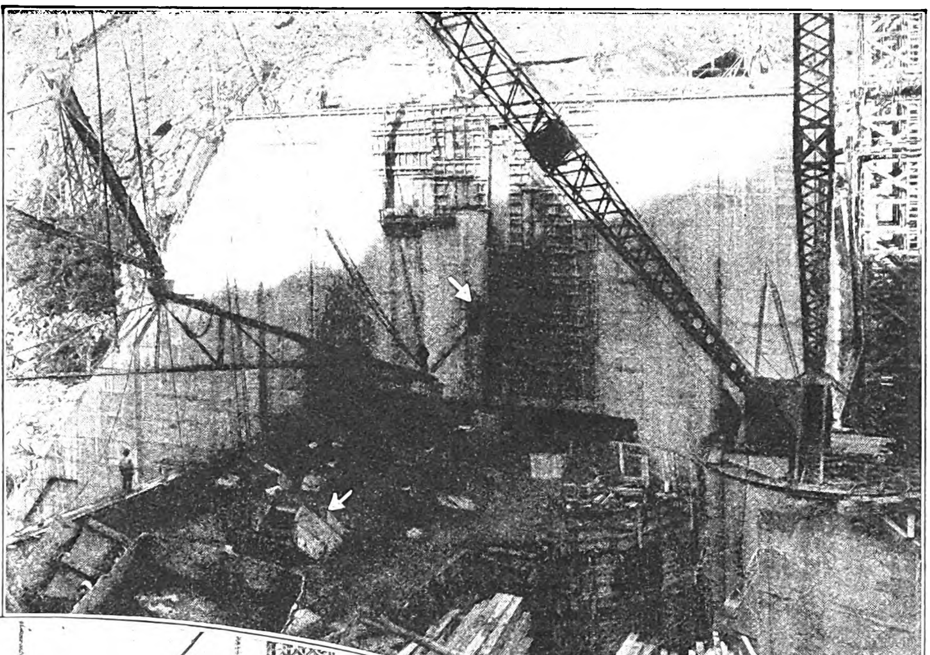


PRE-CAST TRASH RACKS

The arrow points to a man who is helping place the pre-cast concrete units the dam in order to clear the structure altogether.

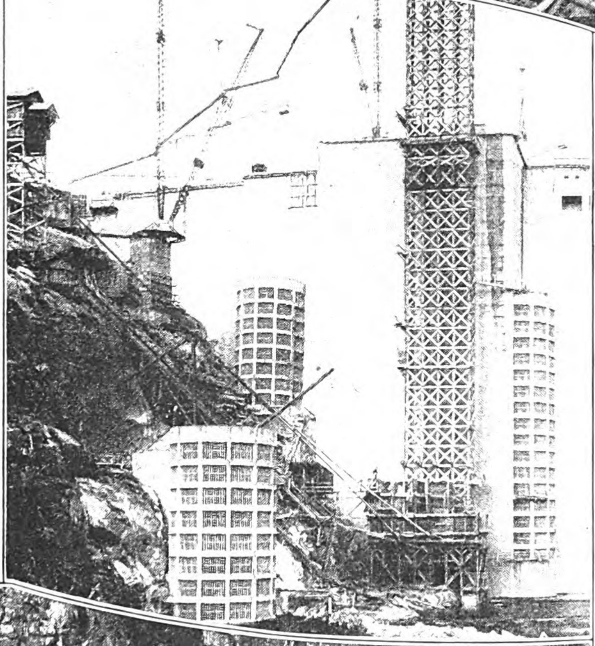
Valves to control the discharge of water through the dam as required are installed at various levels. Openings, designated as supply pipes, supply wells, and discharge conduits, were cast in the concrete as the structure was built. The valves consist of the following: Six 5-foot balanced needle valves; six 3-foot balanced needle valves; six 47-inch by 90-inch slide gates; and six 33-inch by 42-inch slide gates. The valves and their appurtenances consist of over 2,000,000 pounds of metal.

On each opening through the dam there are two controls. The water is admitted through the hydraulically operated slide gate to the supply well and from there the required flow is regulated and discharged by the balanced valve. These valves are of the hydraulically balanced type, which permit manual control of a five-ton plunger under a high head of water.



DURING CONSTRUCTION

Arrows point to inspection galleries and ladderways which were cast into the dam as the concrete mix was being poured



◄ THE UPSTREAM FACE

The screens shown here were built up of reinforced concrete columns and ribs, all of which were pre-cast in a block plant

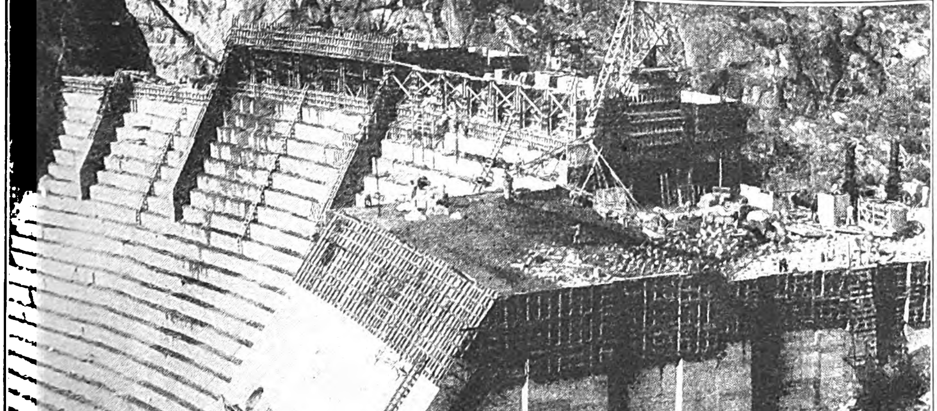
THE six 5-foot balanced valves and the six 47-inch by 90-inch slide gates are installed in the main portion of the dam, having been encased in the concrete as the structure advanced. Three of the 3-foot balanced valves are installed on the lower side of the dam, 124 feet above base, in a special valve house, and have three 33-inch by 42-inch gates installed in the dam in connection with them. Three 3-foot needle valves and three 33-inch by 42-inch slide gates are installed in the concrete plug in the diversion tunnel and permit draining the reservoir to its lowest levels.

The entire upstream face of the dam, below streambed level, was coated to a thickness of 1 inch with mortar applied by a cement gun, and the area above the streambed was coated with mortar to a thickness of three quarters of an inch.

THE 23 to 25-foot diversion tunnel was lined with a 12-inch concrete lining for a distance of 253 feet. On the downstream side of a concrete plug which was constructed in this tunnel, are three of the outlet conduits, with valves and operating chambers to control the discharge from the reservoir.

The shaft leading to the diversion tunnel was cement lined, and two 5-foot by 6-foot ladder wells formed within the shaft to connect with the operating chambers in the tunnel plug.

Concrete lining was placed in an adit, or entrance, to the diversion tunnel and a turbine chamber formed for the 40-horsepower generating plant which furnishes light for the attendants' quarters, and the galleries and roadway of the dam. A shaft 70 feet in depth was sunk through the granite and lined to neat dimensions of 4 feet by 6 feet to give access to the turbine chamber. The top of the dam is finished with a 17-foot roadway, with pre-cast concrete railings.



CONSTRUCTION DETAILS

Inspection galleries, the concrete chute, and tie-stones are clearly visible in this view of the central section of the dam under construction. Siphons are being built on top of the stepped section. Concrete is being poured in the center of the huge mass in foreground

All illustrations courtesy Bureau of Entomology

METHOD OF PROTECTING HOME GARDENS

Insects which attack the leaves of plants in the small garden can be kept in control by dusting the plants with various chemicals

SPRAYING APPARATUS FOR TRUCK GARDENS

In the truck garden or small field, this one-man spraying outfit will provide an effective means of dusting the plants with poison

Our Crop-Destroying Insect Pests

Man's Struggle With the Insects Becomes Increasingly Intense as We Are Attacked by More Formidable Foes

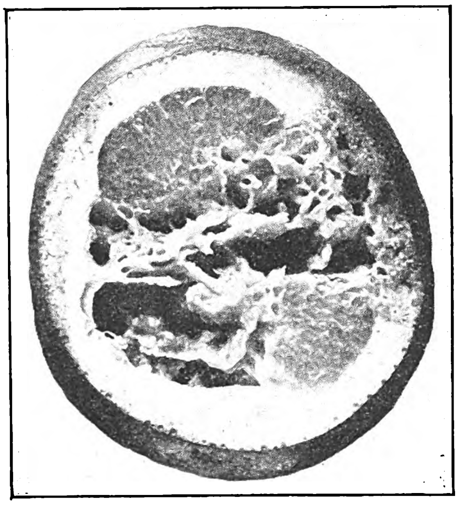
By HENRY W. HOUGH

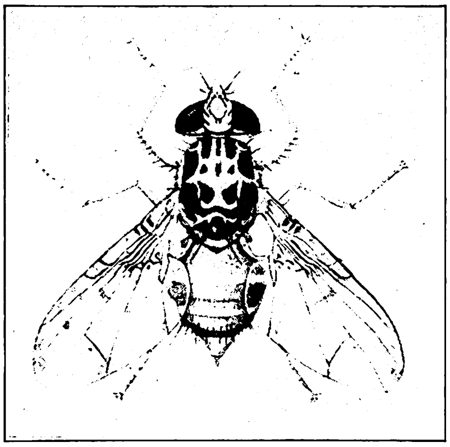
MANKIND is continually harassed by the slow but apparently inexorable onslaught of the countless denizens of the insect kingdom. Our best entomologists agree that we cannot hope to drive out these insidious destroyers of our crops and gardens; the most we can do is to check them—perhaps for but a little while. Too many land-creatures are struggling for possession of the relatively small portion of the earth's surface which rises above the ocean. In regions where the food supply is abundant, the contest is particularly bitter.

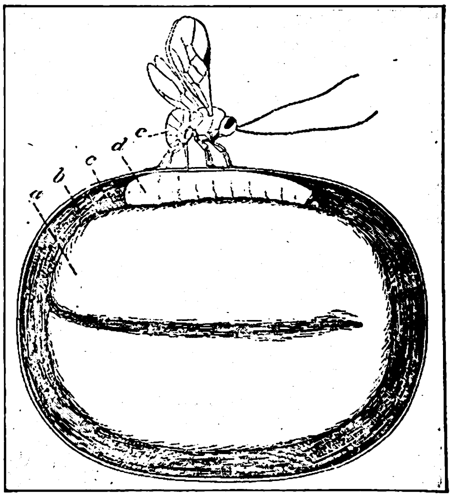
We have learned to cultivate the land and make it yield an adequate supply of food; when the crops flourish and become luxuriant, uninvited parasites arrive. Hordes of beetles, flies, and worms appear, often transported great distances on ships, trains, motor trucks, and other man-made conveyances. If the parasites behave like ladies and gentlemen, we make no great effort to drive them away. But when they propagate too profusely, and make pests of themselves by consuming an inordinate portion of our limited food supply, we finally realize that the insects are more than nuisances—they are our enemies.

One tenth of all crop products of the world are destroyed annually by insects, and in the United States we sacrifice to them more than two billion dollars worth of our agricultural products; this includes at least one fifth of our fruit, one fifth of our wheat, and one tenth of our animal products. The problem is not restricted to the fruit grower, the plantation owner, and the rancher; it is shared by every farmer, truck gardener, and home owner. Despite elaborate quarantines and other well-planned attempts to guard our fields and gardens from certain dreaded insects, they have become established in our midst, and assume increasing importance every year.

In view of recent developments, it is interesting to recall a certain little booklet published in 1918 by the







MEDITERRANEAN FRUIT FLY

Above: Adult Mediterranean fruit fly, which has caused the destruction of millions of dollars worth of fruit. *Left:* Grapefruit cut to show damage done by larvae of the fruit fly. *Right:* Sketch showing how a parasite lays its eggs in the larvae of the fruit fly, under certain conditions

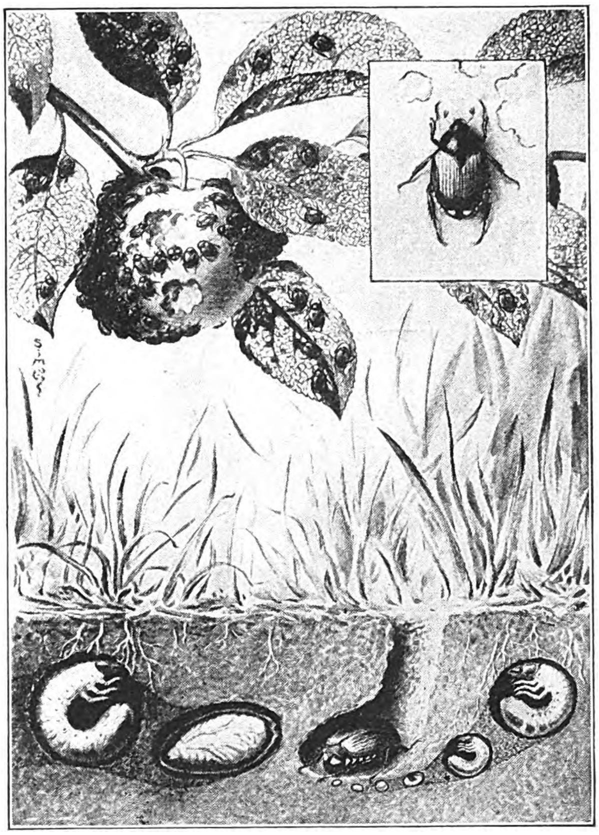
Bureau of Entomology of the United States Department of Agriculture, entitled, "The Mediterranean Fruit Fly." It said, in part, "The horticultural development of the Hawaiian Islands has been almost stopped since 1910 by the activity of two fruit-fly pests—the Mediterranean fruit fly and the melon fly. These two pests are being intercepted continually by quarantine officials at our ports of entry and they are therefore feared by, and are of vital interest to, every fruit and vegetable grower in warmer portions of the Pacific and Gulf coast states."

For 11 years more, the hopelessly outnumbered entomologists were able to keep this dreaded marauder from getting a foothold in the United States. But although "every barrier possible" had been erected in an effort to exclude the Mediterranean fruit fly, the task was too great.

IN April of this year, it was discovered in Florida, already well established in the citrus groves surrounding Orlando. Within a week, 75 trained insect fighters and plant experts were on the ground, quarantine zones were established, an appeal was made for a federal appropriation to provide money for meeting the emergency, and in record-breaking time Congress had made available a fund of 4,250,000 dollars for the greatest defensive campaign of its kind yet undertaken by man.

Every orchard in the state was inspected for the pest. Infested zones and protected zones were charted; in every infested area all fruit and produce were destroyed, and in the protected zones all products were subject to examination before being shipped or transported to uninfested regions. The regulations were more rigid than those prescribed when nations go to war, and several companies of the National Guard were called out to aid the 2000 insect specialists who were directing the campaign of destruction and inspection. But before the infestation had been discovered, almost three fourths of Florida's enormous citrus crop had been moved out of the state through normal channels of distribution. The fly was soon found as far west as Texas and Arkansas, and as far north as Ohio and New York, and now every state in the south is menaced.

Our famous guest, one of the truly cosmopolitan pests of the earth, is hardly more distinguished looking than an ordinary house fly, for which it might be easily mistaken. The female fly drills holes in the skin of fruits and lays her eggs in the cavity. Within a few days the eggs hatch into wormlike larvae or maggots, which burrow and tunnel through the fruit in all directions, feeding as they go. All the damage to the fruit is done during the larvae stage, which lasts three or four months. Then the immature fly emerges from the fruit, finds shelter on the ground or by burrowing a few inches in the soil, and develops into the pupa or chrysalis from which the full-grown fly emerges to start the routine again.

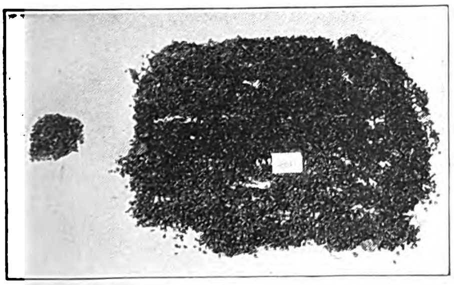


AN ENEMY MAN HAS NOT DEFEATED

Artist's sketch showing habits of the Japanese beetle. The eggs are deposited in the soil, where the immature beetle feeds on grass roots until it emerges in the fall

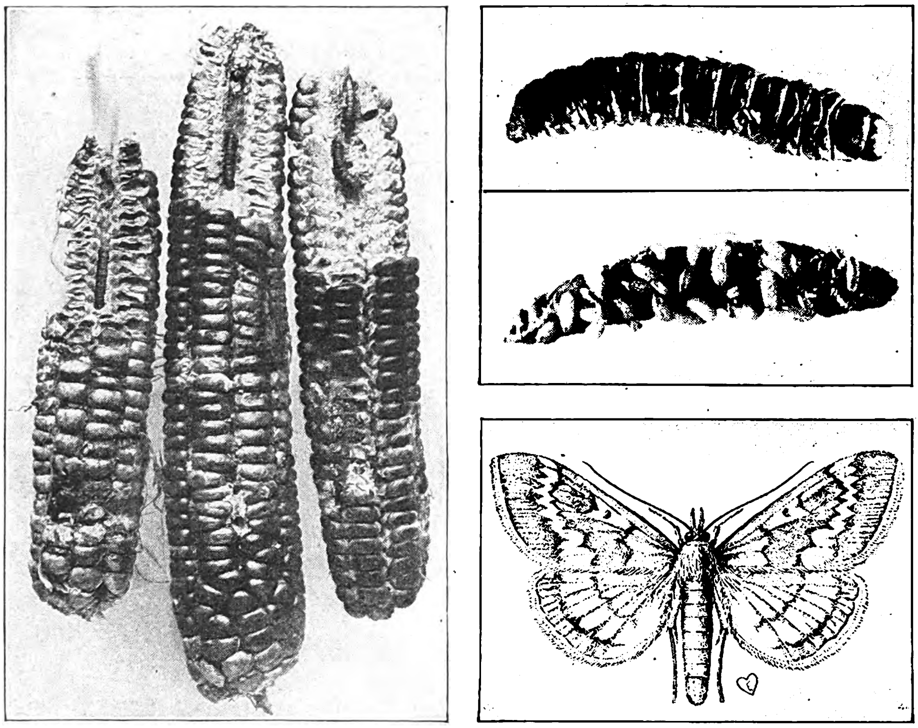
The primary reason for the importance of this particular fruit fly is that it thrives on so many different kinds of growing things, including every common fruit except the pineapple. Watermelons are also immune. It also thrives on many varieties of vegetables, including tomatoes, beans, gourds and egg-plants, and will damage cotton, shrubs, and many species of ornamental trees. For 100 years it has ravaged the warmer agricultural regions of the Old World.

"Clean culture," or the detection, collection, and destruction of all infested fruits, and the elimination of useless or unnecessary host vegetation, is the accepted method of combating the Mediterranean fruit fly. Destroy-



DOES IT PAY TO SPRAY TREES?

The small pile of Japanese beetles was taken from the tree on the left, which had been sprayed; the larger group of beetles was taken from the defoliated tree at the right, which was not sprayed. Several states have been quarantined to retard the spread of these leaf-eating insects



THE EUROPEAN CORN BORER IS HERE

Damage to corn by the European corn borer is shown at the left. This borer attacks more than 200 different kinds of plants, and may do untold damage to important agricultural regions not yet infested. The tiny white specks on the borer at the top of the picture are parasite eggs; the larvae of the parasite are shown in the picture just below, feeding on the paralyzed corn borer. The moth in the illustration is an adult European corn borer (female)

ing many millions of dollars worth of fruit to check the fruit fly seems like killing the dog to get rid of the fleas, but the entomologists know their business. The same tactics were used in checking the hoof and mouth disease in cattle, and in combating the citrus canker in Florida a few years ago.

However, complete eradication is impossible, and a rigorous campaign of clean culture seldom receives the necessary support from fruit growers and farmers, for obvious economic reasons. Under far less favorable conditions the method failed in Hawaii, and recent modifications of the restrictions indicate that a more liberal policy is to be practiced in Florida.

LETTING down the barriers may save from ruin certain fruit growers in the badly infested areas—but we might as well unlock the nation's prisons, or blast the levees that have been erected to prevent Mississippi river floods. In a statement issued to point out that the regulations in the infested region would be liberal in scope, with no intention to annihilate the fruit industry there, Dr. Marlatt of the Bureau of Entomology said, "We would rather let the fly do that."

Although the eggs and larvae of the fruit fly can be effectively destroyed by burning or boiling the fruit, it is also considered important to use poisonous sprays on the trees to kill the adults. Destruction of infested fruits and spraying are remedial measures that should go hand in hand. Natural control, by utilizing parasites and other factors known to be effective in destroying the pest, is unusually difficult in this case. The invader is hardy, and can withstand almost any weather in which fruit can grow, although it is a tropical insect and will become economically important only in the southern portions of the United States. When exposed to direct sunlight, the larvae die rapidly. Certain species of ants eat the larvae, but leave about half of the embryo flies to pupate and mature. Various imported wasp-like parasites have been tried, but are able to reach only the comparative minority of the larvæ which happen to be near the skin of the fruit. About the only hope for effective biological control of the fruit fly is to find pupal or egg parasites, and no satisfactory types have been discovered.

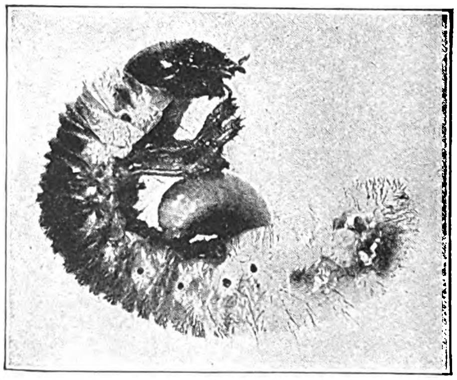
FEW prominent insects have been more successful in a new environment than the Japanese beetle. It is perfectly acclimated, has relatively few natural enemies, and steadily increases its range and the scope of its depredations. In its native land the Japanese beetle is common but not abundant, and is not considered a serious pest. However, since its discovery in this country in 1916, it has become highly important, and is the cause of the present federal quarantine in the states of Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and the District of Columbia. The restrictions in force apply to shipments of all farm, garden, and orchard products; grain and forage crops of all kinds; nursery, ornamental, and greenhouse stock and all other plants; and sand, soil, earth, peat, compost, and manure. Although under the surveillance of federal and state entomologists since its discovery near Philadelphia about 13 years ago, it has spread in every direction.

The adult Japanese beetle is practically omnivorous, and is a strong flier; it is gifted with a canny sense of discrimination, which enables it to shun certain poisons after eating enough to get a slight case of indigestion. It is easily trapped, however, and is susceptible to control with the common chemical sprays used against other leaf-eating beetles. As with the Mediterranean fruit fly, the entomologists' attack was directed originally toward complete extermination of the pest. When it became evident that the beetle was not being checked by that practice, various sprays and poisons were found helpful. But even with these checks, the steady spread had continued.

CLIMATOLOGICAL conditions are ideal for the pest. Some of its parasite enemies have been imported but many of them died in the new environment, others were devoured by secondary parasites, and many died of fungus diseases while being shipped from Japan. The Japanese beetles provide a situation any pessimist would enjoy, for they will undoubtedly do more damage every year, over an ever-increasing area.

From Mexico, or perhaps from one of the Central American republics, our cotton growers acquired a prize pest—the cotton boll weevil. About 90 percent of the cotton-producing area of the United States is infested with this pest. It destroys more than 200 million dollars worth of our cotton every year, and farmers have grown so accustomed to it that the damage done by the weevil is seldom mentioned now except when some new area becomes infested.

The adult cotton boll weevil is a



NATURE'S WAR

Drama in the insect world; larvae of the tiphia wasp killing a Japanese beetle grub peculiar-looking creature, with an elongated proboscis or snout; it is about one fourth of an inch long and a third as wide. During the fruiting season of the cotton, in the spring, the female weevil deposits her eggs in cavities in the squares. About three days later the eggs hatch, and the larvae or grub begins to feed on the plant.

THE weevils breed at an enormous rate, but are held in check to a certain extent by natural factors. Many are killed by cold weather while hibernating during the winter, and during the dry season many of the larvae die from the excessive heat. Many insect parasites prey on this weevil, most of them attacking the eggs in the square or in the cotton boll. Ants eat many of the larvae.

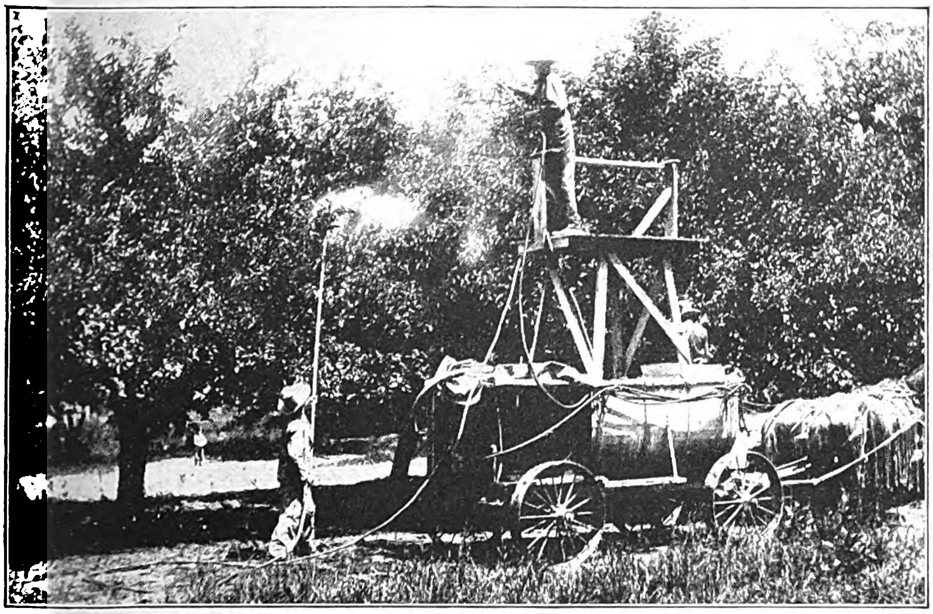
The cotton growers are urged to give careful attention to cultural practices, such as selection of seed, preparation of the soil, and the time of planting. Poisoning the weevil is recommended also, but as a supplementary measure.

One of the most discussed insects in America is the European corn borer, a caterpillar which causes considerable damage to crops in Michigan, Indiana, Ohio, Pennsylvania, New York, Massachusetts, and Maine. It is not yet prevalent in the more important corn producing states, such as Iowa, Nebraska, Kansas, and Missouri. Although primarily a corn insect, this borer has been found on more than 200 different kinds of plants. Due to natural control, it is of little economic importance in Europe, although it is prevalent in certain localities.

The defensive campaign in this country is directed toward a co-operative plan of disposing of all remnants of the corn crop early in the spring, before the borer changes from the caterpillar to the moth stage. Poisons, traps, and putting to pasture fields infested with this insect have little effect in controlling it. Extended studies have been made in an attempt to find native and European parasites of the borer, but the prospects for stimulating natural control of the pest are far from encouraging. The best method to improve the situation in the infested areas is for the growers to co-operate in clean-up campaigns. If, or when, the corn borer spreads to other parts of the United States, the damage it will do will be far more severe than in the regions now affected.

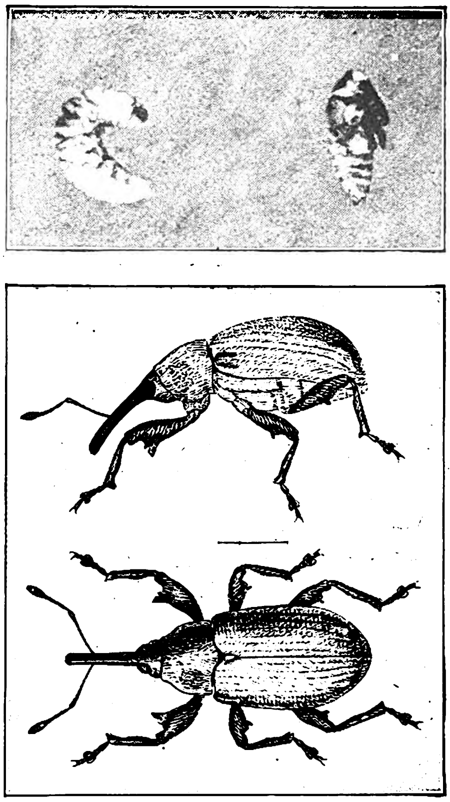
ALTHOUGH the four major crop-destroying pests described above are probably the greatest menace to American agriculture at the present time, there are many other species and varieties of insects which are of considerable economic importance. Among these the most prominent are the coddling moth, gypsy moth, peach moth, alfalfa weevil, pink boll worm, Mexican bean beetle, cattle grubs, and grasshoppers. Many insects exhibit amazing ability to adapt themselves to changed conditions and a new food supply; sometimes an insect infesting crops of one kind will turn its attention to plants of an entirely different nature.

We are beginning to realize that birds are an important factor in controlling insects of many kinds, and are learning more and more about the parasites and diseases to which our important pests are susceptible. In a few instances the airplane had proved helpful in spraying large areas infested with destructive insects and fungi, although in many cases such operations have been of doubtful value.



POWER SPRAY APPARATUS FOR DUSTING FOLIAGE OF LARGE TREES

Although most of the fruit-destroying pests are borers, many of the adult flies and moths can be killed by dusting the foliage of the trees with carefully selected poisonous sprays



MEXICAN COTTON BOLL WEEVIL

The grub of the cotton boll weevil, shown at the top of the illustration, destroys more than 200 million dollars worth of American cotton every year. The long-nosed creature is the adult weevil, highly magnified

While the numerous "parasite zoos" of the world continue to raise and distribute certain deadly enemies of our insect pests, the ordinary gardener will have to rely for some time on the preparations of the insecticide manufacturers. In most cases, these preparations will yield good results, if one follows the directions supplied by the manufacturers. The home owner, gardener, and grower of valuable shrubs, trees and flowers will find in *House Beautiful* for March, 1929, a valuable chart prepared by Mr. C. F. Reeves-Carpenter, entitled, "Controlling Insects and Fungus Diseases." It presents the necessary information concerning types of pests, identification, type of injury, and recommended control measures for caterpillars, beetles, borers, aphids, scale, leaf miners, and fungi.

ALTHOUGH the activities of the Bureau of Entomology of the United States Department of Agriculture are primarily concerned with scientific research, it does much practical work in the field. The bureau employs many specialists who make a thorough study of insects injurious to crops, and who develop practical methods for eradication and control of pests. Led by Dr. C. L. Marlatt and Dr. A. L. Quaintance, the government entomologists are co-operating with state agencies in one of the most difficult undertakings in the history of the race.

What Is Wrong With Men's Clothing

Women's Clothing—Light, Thin, Ventilated, Hygienic—Has Been Rationalized. Men Still Wear Winter Clothing in Summer, and Their Clothing Reduces Their Efficiency All the Time. A Revision Is Due

By **DONALD A. LAIRD, Ph.D., Sc.D.**
Director, Colgate Psychological Laboratory, Colgate University

CLOTHES make the man in respects more vital than mere appearance and social acceptability. It is true that a slender man looks more stout in a double-breasted coat, or that suiting with a vertical stripe makes the short man look taller. But these are not especially vital factors. Research and scientific opinion are rapidly accumulating data which indicate rather definitely that clothing may almost remake the course of human history.

This newer knowledge helps one understand why we make more mistakes in summer, why usually sensible Germany has a growing number of nude societies, why the Alps are healthful, how to keep cool in summer; and it also makes us pause and wonder about man's place in the decades to come.

White civilization at present is dominated by the male. History records numerous places, however, where women have dominated. Even now the explorers bring back to us reports from remote places where women dominate. This newer knowledge about clothes may make us wonder whether a female dominated civilization lies in the not so distant future.

FOR years it has been known that slightly more boy than girl babies are born. Boy babies are the more delicate, however, and there are more early deaths among them. By the time high school age is reached the ratio has been altered so that there is an excess of females. As years go on, this ratio is changed still more, industrial accidents eliminating more men than women; disease also reduces the number of men more than it affects women.

Total numbers alone will not necessarily determine which sex will dominate. We see a small handful of Englishmen dominating dark-skinned India. Vitality and ability are fully as significant as mere numbers. And on this point, also, modern science would point to a change to a dominance by the so-called gentler sex.

His Majesty's medical inspectors have just reported on thorough studies of English boys and girls who are entering industry. They report definitely that the girls are much better developed physically than the boys. It has been known for many years that although women do not usually have the muscular strength of men, they are in the long run possessed of greater physical stamina and resistance. The royal medical inspectors are inclined to attribute a large amount of this difference to the clothing which is being worn.

It is only in the last two decades that women's clothing has differed essentially from that of man; and the puny, almost neurasthenic, women typical of the 80's seem largely to have disappeared, along with the disappearance of several square yards of woolen clothing per woman.

Fifteen pounds of clothing was the average worn by men a few years ago, and women wore "a little more," according to the books. Men are still wearing about the same gross tonnage of clothes as ever, while women's clothes have only about one tenth of their former weight. This means that men are still wearing about a tenth of their body weight in clothes, while a dog, which seems to stand cold weather remarkably well, carries only about one fiftieth of his weight in fur.

A TEST THAT TELLS—ON THE MAN

When we inspect the clothes worn by dancing marathoners do we wonder that a woman dancer will wear out two or three partners? We are not all dancing marathoners, but—

Man has to pay a price for this extra weight in several unusual ways. Energy has to be used, for example, to carry the extra weight around, even though the energy is not consumed in useful or productive work. This excess clothing worn by men also results in men living in a self-produced tropical climate in both summer and winter within their clothing, while women live in the atmosphere of the Alps. Tropical climates are enervating; the Alpine atmosphere is invigorating. The temperature within the clothing of the average man is 87.8 degrees, Fahrenheit; for women's clothing it is only 80.6 degrees. The relative humidity inside men's clothing is 70 percent, and for women it is only 55 percent. The observed consequence is that men suffer from heat stasis and from excessive perspiration.

A miracle of nature is the way in

which the human body is kept at a uniform temperature, almost regardless of the external temperature in which it is placed. Any marked change in the external temperature throws additional work on the heat regulating mechanism and the metabolism of almost every cell of the body. Our bodies have continually to radiate heat in order to keep their temperature at the healthful constant of 96.8 degrees, Fahrenheit. When, however, the environment has a higher temperature and a higher humidity, and the air circulation is diminished by the clothing, the body cooling function is hampered. Thus, regardless of the room temperature, men's bodily mechanisms have more difficulty in keeping the body temperature at nature's point, due to the secondary air environment within the kind of clothing they wear.

THUS the basal metabolism is lowered, a load which may reach dangerous proportions is thrown on the sweat glands, and this affects the water distribution in the body and may influence the kidneys and other vital organs.

These statements are not based simply upon scientific logic, although the logic is plain. These effects have been observed by such men as Dr. E. S. Sundstroem of the University of California, who has studied not only the white population of Queensland, Australia, but also more than 700 white rats in specially equipped rooms where temperatures and humidities could be produced at will. Dr. Leonard Hill, the eminent English physiologist, has also noted these conditions and is urging radical changes in the clothing of men. Dr. E. Friedberger of the University of Griefswald recently presented the conclusions of a long study of clothing at the Berliner Gesellschaft für öffentliche Gesundheitspflege, which were essentially the same as outlined in this article.

How well sunlight could reach the bodies of men and women was given special emphasis by Herr Doctor Professor Friedberger. Using strips of paper which were sensitive to light he discovered that much light reached the body surface of clothed women, but that the sun's rays do not penetrate men's ordinary clothing. Part of them will penetrate a shirt, but if it is covered with a coat, practically no light reaches the surface of the body.

The admission of air is of perhaps equal importance with that of vitalizing light rays, and in this case, also, the clothing of men extracts a penalty.

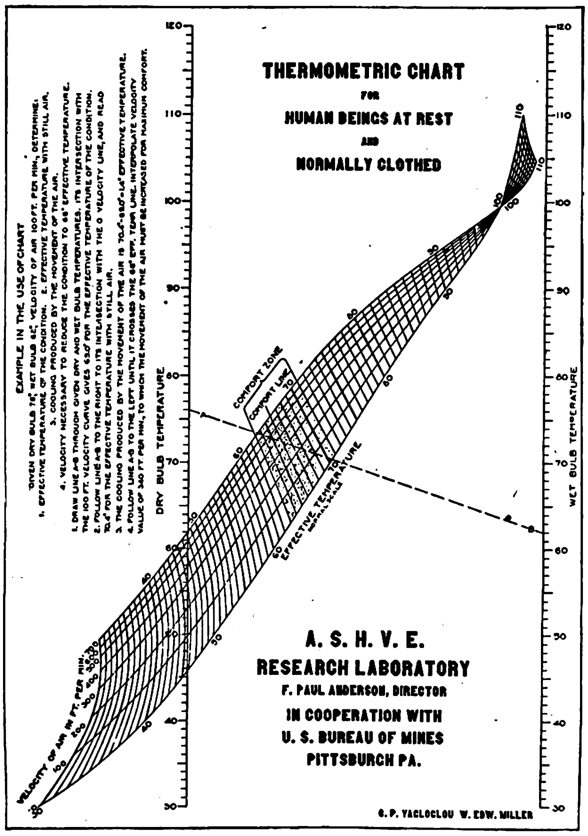
Ultra-violet light penetration through ordinary clothing materials has been studied intensively by the Bureau of Standards of the Department of Commerce. They find that rayon, batiste or nainsook cotton, and linen allow more of these rays to pass through than do pure silk or wool. When the materials are dyed or slightly yellowish with age, the passage of the ultra-violet is cut down. Woolen is only about half as transparent to these rays as is white cotton. The weave of clothing greatly affects its transmitting power. Crocheted or knitted weaves allow the most light, and also air, to bring their benefits to the surface of the body.

Better than an overdose of ultra-violet, as on the seashore with its annoying first day sunburn, is a continual mild exposure, such as would be given by the correct selection of clothing. Much of the benefit from resting at the seashore comes from the ultra-violet baths taken on the beach, although this should not be overdone the first few days. Other advantages which make people erroneously think that sea air is intrinsically bracing, come from the breezes which unburden the heat-regulating machinery of the body by removing the layers of stagnant air between body surface and outer clothing. Lounging at the shore in a wet bathing suit throws too much strain on the heating plant, however.

Perspiring in hot weather is a good way to keep cool, since each quart of perspiration means that the body has been relieved of about 500 calories. However, a few people do not perspire. These unfortunate few should drink hot beverages in warm weather, since extra perspiration is induced by the hot liquid. Everyone drinks more during hot weather, and adding just a pinch of ordinary table salt to the water is helpful since it replenishes the abnormally high loss of salt from the body during summer perspiring.

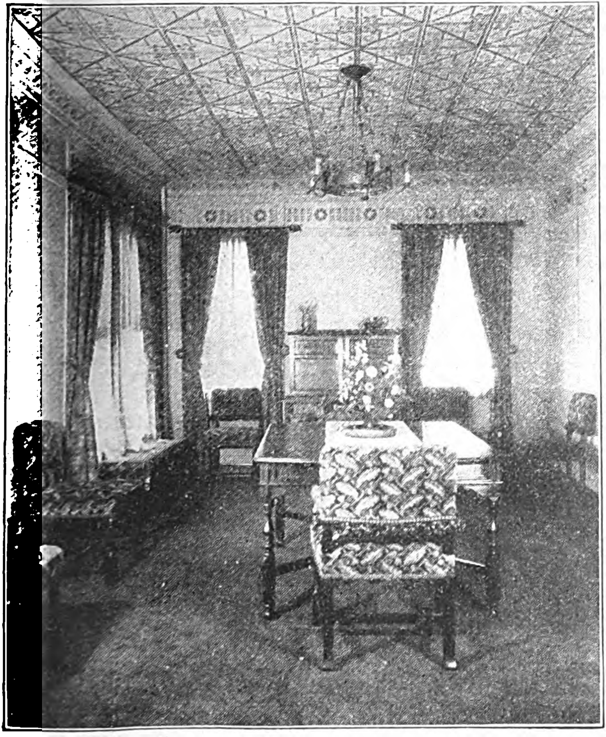
THOMAS A. EDISON always has a fan with him in hot weather. You may never have seen it in his photographs, but it is always there. His loose clothing also amounts to a fan, since it allows minute air currents to displace the overheated air near the body surface. On an especially hot day the best way to keep cool is to keep the windows closed to prevent hot outside air from entering; to pull the shades to keep out the heating sun rays; to turn on an electric fan; to keep calm; and to wear loose clothing.

Food should also come into consideration. Proteins should be reduced and carbohydrates increased. Fruits, salads, green vegetables, rice, fish in



TEMPERATURE-HUMIDITY RELATIONS

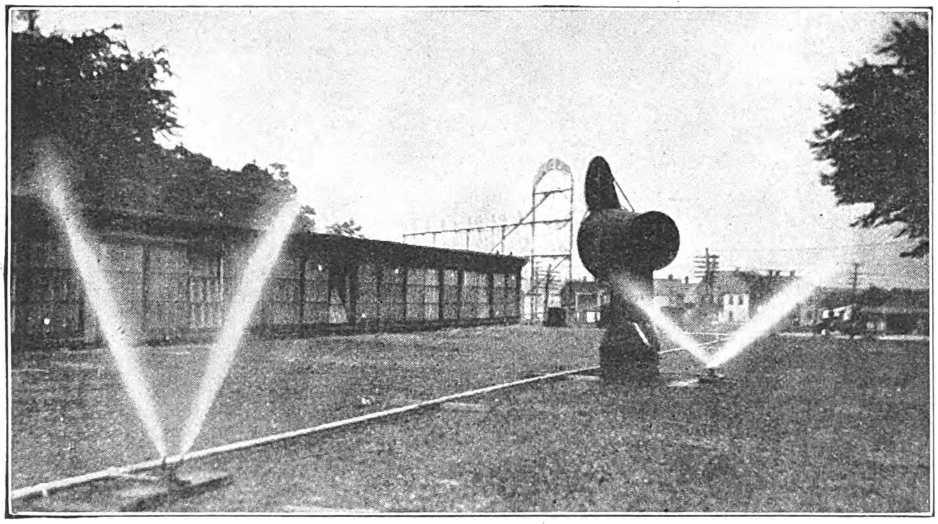
Data worked out by the American Society of Heating and Ventilating Engineers and the Bureau of Mines



A COOL, QUIET DINING ROOM

This home at Urbana, Illinois, is equipped with walls and ceilings which insulate against heat and noise moderation, fowl, and dairy produce are best.

Men will also be cooler in summer if they wear suspenders rather than a belt. However, since they should also go without a coat they may feel conspicuous if wearing suspenders. This dilemma is easily solved by wearing hidden suspenders and a very loose belt. The belt adds to one's discomfort, not especially because it binds the blood vessels, but rather because it stops the circulation of air within the clothing. Tightly fitting garters do hamper the blood stream, as well as quickly becoming unsanitary themselves. A good grade of men's hose does not need garters to keep it looking trim. If supporters are necessary, because of thin calves, preference should be given to those which clamp to the shirt and do not constrict the leg, and which, incidentally, keep the shirt trim and secure when the coat is sensibly left off.



FIGHTING THE DETRIMENTAL EFFECTS OF CLOTHES

The Dennison Manufacturing Company makes the wearing of clothes less uncomfortable in summer by spraying the roofs of the buildings, cooling directly and by evaporation

VENTILATED oxfords are unusually comfortable. I have worn them for years during warm weather, but have had great difficulty obtaining them in the last year or two since they seem to have gone out of fashion. I have been able to obtain them lately only from left-over and shopworn stock several seasons old. I have been told this spring that they will have to be made to order at a rather high price.

Since constriction is an important item against the garter, the same consideration should annihilate the tight fitting starched collar entirely. Collar manufactures have been having trouble finding a market, lately. Perhaps men are at last rationally revolting against this last remnant of the corset which was originated as a protection against lance and sword thrusts. The blood vessels in the neck are large but are limited to a small area. They are important vessels which carry great quantities of blood to the brain. "Whenever you suffer from headache," said Dr. Royal S. Copeland, "my advice to you is to loosen the collar." In addition to constricting the circulation of the blood the tight, stiff collar prevents the free circulation of cooling or refreshing air currents over the surface of the body. Tight pajama belts affect only the circulation, but that is enough to bring them into court.

The collar, garter, long underwear, and lined clothing result in only the face and hands of men being exposed to the sun and air. In the case of women, fully one third of the body surface is exposed more or less to sunlight and ultra-violet, while practically her entire body surface is continuously ventilated by air currents. She is much better, physically and mentally, for this. So we find Dr. Ephraim R. Mulford, president of the New Jersey Medical Society, saying: "To-day our American women are in better physical condition than our men." It was only a few decades ago that Mary Walker agitated for womens' suffrage and created a sensation when she insisted also upon the right to wear men's clothes. She may have been right about the ballot, but she was dead wrong about the clothes.

There is also the matter of cleansing clothes. In this, women again have the advantage, their light garments and underclothing being readily and frequently washed at home. It is far from a luxury for a man to invest in enough hosiery and underclothing to allow a fresh change each day. Shirts should be allowed to air alternate days. Clothes closets should be provided with ventilators which allow outside air to enter, keeping the clothing in a more sanitary condition as well as making life a bit more miserable for moths.

Why people started to wear clothes has puzzled science for a long time. Some think wearing clothes was started by women who wanted to make themselves more attractive. Whether or not this is the explanation, it is true that this tells us much about why they wear the particular clothes they do. Another theory advanced to explain the beginning of clothes was that they were adopted to keep the wearer warm. Still another theory is that clothes were adopted because people began to feel immodest about their nudity. This is difficult to accept because among isolated tropical peoples where no clothing is worn it is considered immodest to hide the body; the general principle is that any sudden change in the kind of clothing worn is considered immodest, and it is certain that, if immodesty means attracting unwarranted attention through dress, a sudden change would cause such a reaction. Another theory, recently advanced by Dr. Knight Dunlap, the psychologist, is that clothes originated in tropical regions and were shreds or rushes which served the purpose of driving flies away.

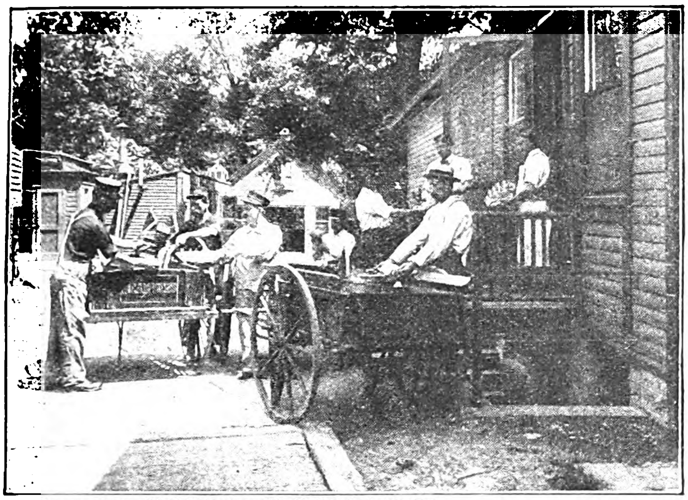
Whatever the origin of clothes we can agree with Langdon-Davies who has just said "the fact that we value people by their clothes, judge them by their clothes, fall in love with them by their clothes, means that all sorts of unfortunate results might happen if our standard of judgment, the cynosure of the eye, suddenly disappeared."

Regardless of how clothes originated or what would happen if they were suddenly redesigned, we should heed the warning provided by scientific research which indicates that clothes may ruin man unless fickle fashion or common sense bring about a change.

WOMEN are just as intelligent as men, and are capable of doing the work of an industrial executive, as great numbers of them have shown. With their equal brain power, their dress, which adds to their mental and physical efficiency, may give them an increasing advantage over men in directing our civilization.

"By 1975," says Dr. Walter B. Pitkin, in discussing the decline of the American mind, "the present super-salesman and high-powered executive will have gone. Some quiet spinster with a world radio telephone at her elbow and an automatic statistical computer in her office will handle more big business in a morning hour than such gentlemen get through in a week of golf and highballs at their country clubs."

¶ *The old question, "What becomes of all the pins?" is paralleled by the question "What ultimately becomes of all the light that goes out into interstellar space?" Next month this will be the interesting subject of Professor Henry Norris Russell's article on astronomy. It should interest you.*



Photographs courtesy Elwin R. Sanborn, New York Zoological Society

MEAL TIME AT THE ZOO

The commissary department of a great zoo issuing rations which will be taken by keepers to animals in widely separated buildings

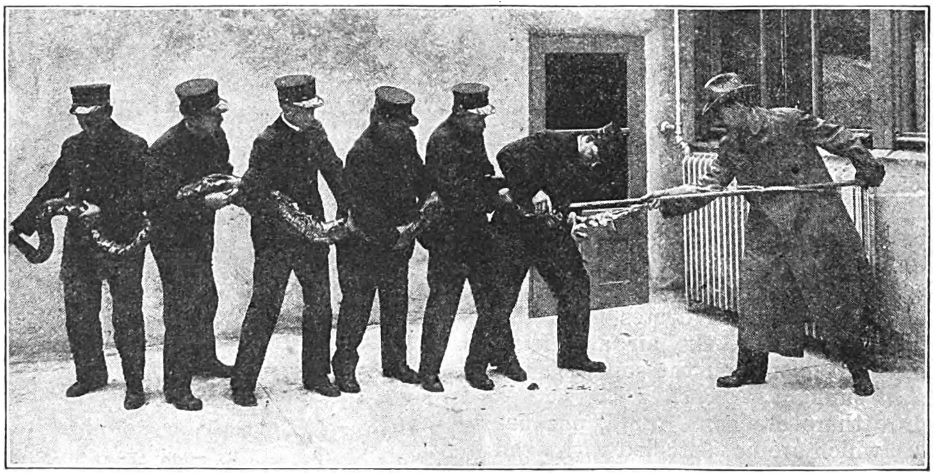
FOOD FOR NON-PAYING GUESTS

Palates differ widely in the animal world. Rich foods in a great variety are in this zoo kitchen which looks like that of a hotel

Catering for the Denizens of the "Zoo"

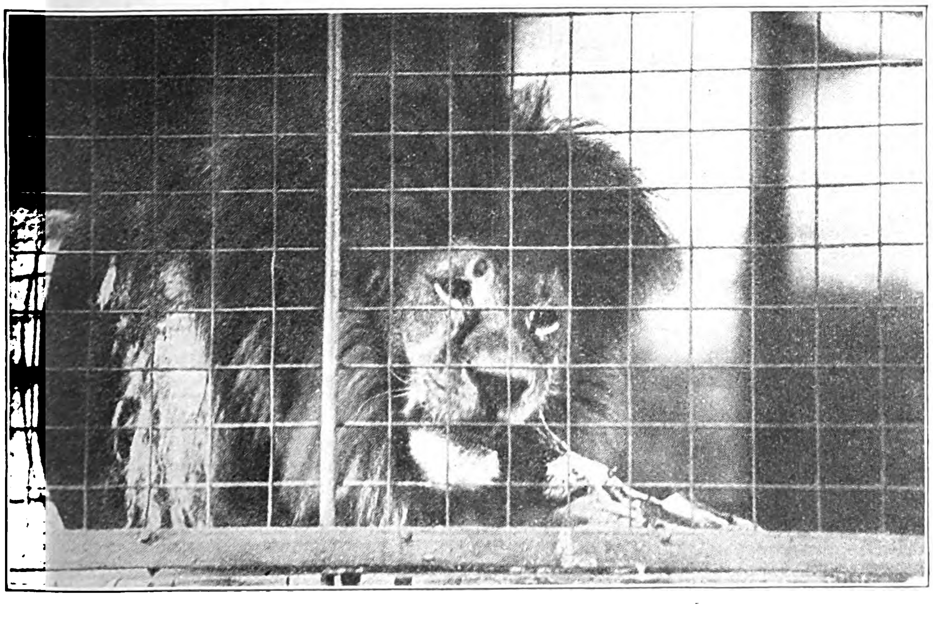
NEARLY 50,000 dollars a year is the total butcher, grocer, green grocer, and fish bill for the 3000 living creatures in the New York Zoological Park. The kitchens are out of the beaten track. At certain times of the day a peculiar type of push cart starts out on the journey to the widely separated animal and bird houses and its arrival is apt to be received with audible marks of delight. Through the service roads come the supplies to the commissary department.

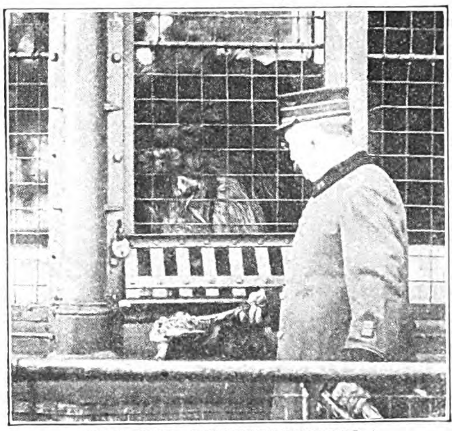
The mammals require daily: 250 pounds of beef, 50 pounds of fish, 175 loaves of bread, 1 ton of hay, 15 bushels of grain, 100 heads of cabbage, 450 bananas, 150 apples, 50 oranges, and 25 quarts of milk. This is not all, but the full list would tire. Some of the big snakes are content with a quick lunch every three or four weeks. A small pig is a delightful morsel but is rather distending for the first three days. The rarer the animal, the more expensive the diet. The short-lived duck-billed platipus used to consume over $4.50 worth of meal worms and shrimps every day. Even this did not keep away the grim reaper. Everybody and everything eats in the Zoo and there is never any talk of the high cost of provisions.



THE PYTHON TAKES NOURISHMENT

Sometimes a python or a boa constrictor is forcibly fed. Then there *is* a circus. There is about as much fun holding a large, slippery snake of this kind as in holding a fire hose





FELINE CONTENTMENT

A 12-pound piece of beef is enough for a lion in a cage but a generous quantity of cod-liver oil for dessert is a poor substitute for what he'd probably get were he in the jungle. Lions are not fed horse meat as many people think. It is entirely too expensive even for His Majesty

Fungi That Kill

Certain Fungus Forms of Life Attack and Destroy House Flies, Mosquitoes, Caterpillars, Butterflies, and Fishes

By DR. E. BADE

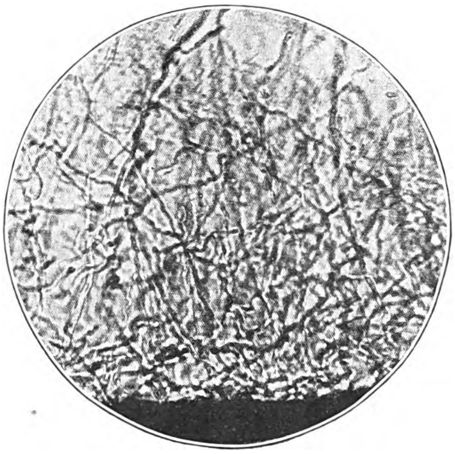
LOWER plant life, first thoroughly studied by means of the microscope, is not far different from the plant life of field and forest. In both types of life, the inconceivably small and the large, there are forms which from man's point of view are either beneficial, injurious, or indifferent.

It is neither wise nor right to consider the minute forms as enemies of the higher plants whose sole duty is their destruction or injury. True, there are a few, a very few, forms which are dangerous to man and do become pests, but many more of them are absolutely essential for our civilization.

ALL fungi are parasites, for they take organic material, the carbohydrates, from other organic substances. Usually this is obtained from dead and decaying material. They must do this because they lack chlorophyl, the green coloring matter of plants which enables the possessor to manufacture carbohydrates from the carbon dioxide of the air and from moisture taken from the soil with the aid of sunlight.

But there are some fungi, peculiar ones, which are not satisfied with dead matter; they attack living things, not only plants, but animals as well, robbing them of their life's fluid and causing their destruction. These particular fungi demand certain definite food conditions in order to develop and grow to their greatest vigor. If these conditions are lacking, the fungi do not thrive but just vegetate.

The distribution of terrestrial forms occurs through the air, the spores being carried by the wind. A few are provided with spray devices which hurl the spores in all directions. Such a device is used by the fly killer, *Empusa muscae.* The spores are hurled great distances and when a fly is hit, the spore or conidia, which is surrounded with a glue-like gelatinous mass, remains attached at the place of contact.



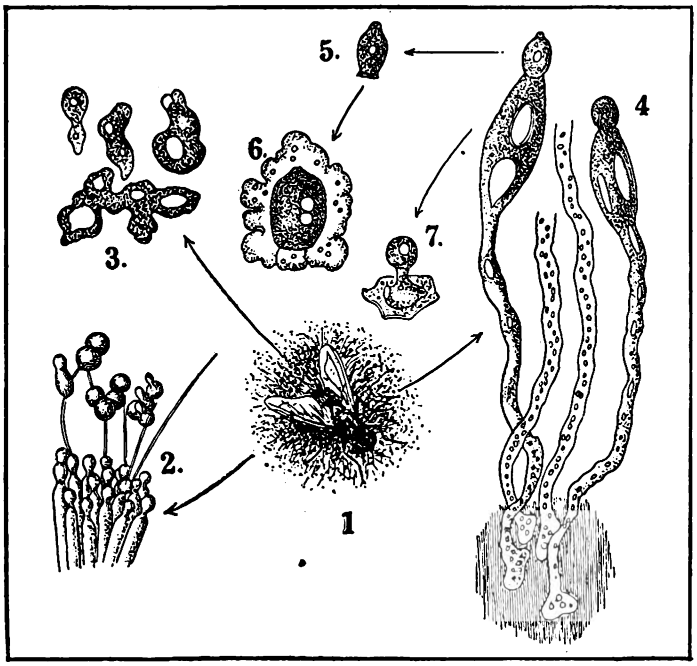
CATERPILLAR CROSS-SECTION

This magnified cross-section through a caterpillar shows infection of fungus

It is now the firm intention of the spore to enter the body of the fly at the first convenient spot. The spore, in order to accomplish this, proceeds to grow a tube which elongates at its tip. This tip feels along the body seeking a breathing pore on the fly's abdomen through which it may easily enter into the body. If the tip does not find the pore, it seeks a weak spot on an abdominal segment and here it pushes through the thin skin.

ONCE the tip has entered, it begins to grow at a tremendous rate, spreading out into all parts of the body. Here short, variously formed segments like those of yeast are produced, which suck out the entire juices of the fly. After the entire body has been filled with the fungus threads, the fruiting bodies of the fungus break through the softer tissue of the abdomen. These produce new spores by the million, sending them out through the air, so that other flies may be infested with this disease.

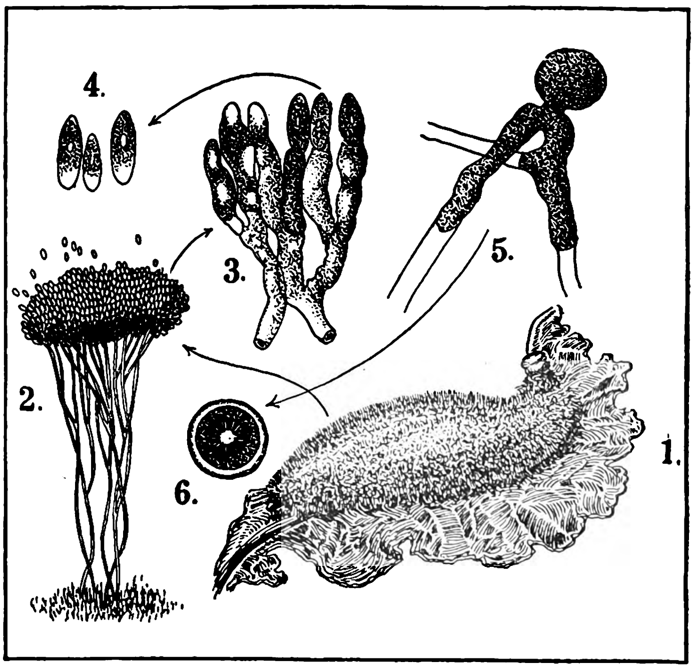
A fly that has once been attacked



All drawings by the author

EMPUSA MUSCA—FUNGUS THAT KILLS FLIES

1: Dead fly, with spores. 2: Fruiting bodies. 3: Vegetative cells. 4: Conidia bearing cells. 5: Conidia hurled into space. 6: Conidia surrounded with ring of glue. 7: Secondary conidia



FUNGUS THAT KILLS CABBAGE BUTTERFLIES

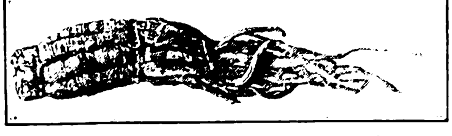
1: Dead caterpillar surrounded with veil of spores. 2: Enlarged spores on back of caterpillar. 3: Divided spore capsules. 4: The conidia. 5: Formation of zygospores. 6: A zygospore by this fungus, loses its speed and dexterity in flight. Each of its motions seem heavy and painful. It prefers to sit still in one place, motionless, sick. A few days after it is infested it is dead. Then it is surrounded with a white or yellow halo, a halo consisting of ripe spores of the fungus that killed the fly, spores that are ready to attack other flies.

Other similar fungi are always found when certain insects have multiplied to excess through exceptionally favorable conditions. Then the lower fungi produce real epidemics among these insects, killing off the majority. It is under such conditions that the fungus *Entomophthora spaerosperma* attacks the caterpillar of the cabbage butterfly, veiling it in white mold. This fungus develops long threads which extend far out of the body of the caterpillar. The fungi belonging to this group also develop, besides the asexual spores, so called "zygospores" which are formed by the union of thread cells. These preserve the life of the fungus during unfavorable conditions. Such long-lived spores are not produced by the fly killer.

MEMBERS of the species *Lamia* attack mosquitos. This species develops sterile cells between the spore cells which project above them.

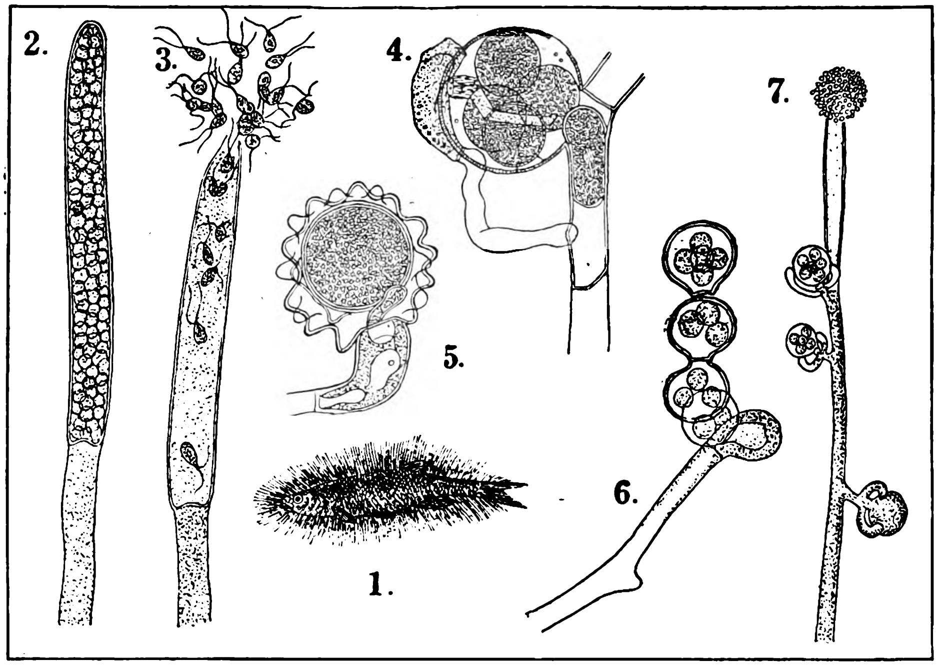
The forerunners of today's fungi were probably inhabitants of the water. Such an aquatic fungus group is *Saprolegniineae*, the majority of which attack dead and decaying material. Some of them have become true parasites and they induce some of the more virulent diseases of fish. Such aquatic fungi are always found in all natural waters.

When a fish is attacked by these aquatic fungi the fungus first spreads the length of the fish upon the skin. Then shoots are sent into the sides. From here root-like structures or "holdfasts" are sent into the skin. In this way the fungus lives vegetatively for a time. Later the spores are provided with two small cilia or hairlike members so that they are enabled to swarm freely about in the water. After a time they come to rest, cast off their skin, and are again active. At last they come to rest again and the spore begins to germinate, sending out its tubes. On propagation through conidia or spores, the tips swell to spheres; these break into pieces and germinate on a suitable spot. The third method of propagation occurs through egg cells, the so-called oospores, which are able to withstand unfavorable conditions.



HAIO-TSAO-TON-TSCHONG

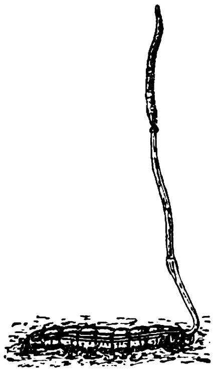
This is the "summer-caterpillar-winter-plant" used by the Chinese for medicine



AQUATIC FUNGI IN DIFFERENT STAGES OF THEIR CYCLES

1: Fish killed by *Saprolegnia*. 3: Zoosporangium before swarming. 3: Swarming spores leaving the zoosporangium. These spores swim freely about in the water. 4: The oospore or resting spore. 5: An aquatic fungus attacking water animals. 6 and 7: Aquatic fungi

Especially dangerous for fish are the conidia or spores of *Saprolegnia* which are much branched. If they enter the gills, the fish is almost invariably condemned to death, for the fungus finds the best possible conditions for its growth and development in this position. Usually the aquatic fungi attack only those fish which have become wounded in some manner or other, especially if their skin has been injured. This explains the death of many fishes returned to the water by fishermen, after rough handling.



A FOOT IN LENGTH

A fungus which produces fruiting bodies which extend a foot above the caterpillar

Of the *Pyrenomycetineae* group, the species *Botrytis bassiana* is the most dangerous in the cultivation of the silk worm. The caterpillar attacked becomes sluggish in its movements, stops eating, and usually dies 12 days later. Then it has become mummified. The germinating tubes of the spore penetrate the skin of the caterpillar, divide in the interior, and grow into the muscle and fat bundles where they cut off cylindrical segments. They enter the blood where, by budding, new shoots are developed, which increases the quantity of fungus mycelium or body of the fungus within the caterpillar. This mycelium again leaves or grows out of the dead caterpillar which has become mummified, and covers it with a white veil of colorless fruiting bodies consisting of short clubs containing the spherical tailed conidia.

Similar fungi have been used to control other insects by disease, especially the dangerous (at least to crops) grasshopper, but the experiments have not been especially successful.

THE fungus forms of *Cordyceps*, the club tube fungus, which is especially well represented in the tropics and sub-tropics, produce on the insects they have killed, especially caterpillars, long-fruiting, club-shaped bodies which are brightly colored. The interior of the caterpillar is entirely filled with the fungus mycelium in such a way that the shape of the insect is perfectly preserved. Various forms of this fungus attack beetles, grasshoppers, spiders, caterpillars, the pupa of butterflies, and so on. In a number of foreign forms the clubs may attain a length of 29 or more inches.

The fungus *Cordyceps sinensis*, found in eastern Asia growing upon caterpillars, is considered in China an exceptionally well liked and expensive medicine. The mummified caterpillars are packed in bundles and are brought upon the market under the agglutinated name of "summer-caterpillar-winter-plant" (Hiao-tsao-ton-tschong).

The Truth About Snake Stories*

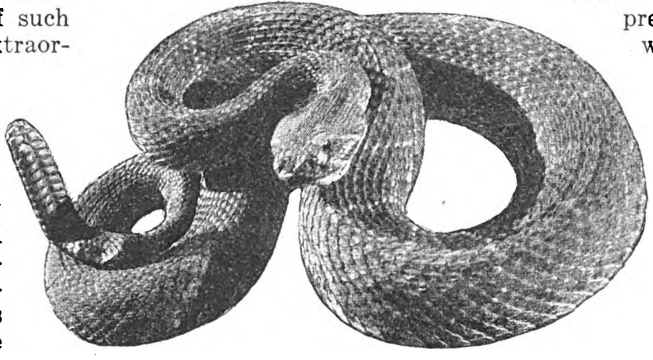
Fish Stories Pale While Snake Stories Hold the Fort, for There Is Usually Not a Word of Truth in Them

By KARL P. SCHMIDT
Assistant Curator of Reptiles, Field Museum of Natural History

THE real truth about snake stories is that they are all too likely to be untrue. The stories popularly believed about snakes are legion, and unquestionably the amount of misinformation current about them greatly exceeds what is actually known to the average man. "Fish stories" as a class are mere exaggerations, while reptile and snake stories are more fanciful or truly mythical elaborations of a smaller foundation of fact. Many of the beliefs about snakes, and about reptiles in general, do have some original basis in observation. When critically examined, however, this modicum of truth may prove to be infinitesimal, or the observable facts may prove to have been wrongly interpreted. The tenacity of life of such misinterpretations is often extraordinary.

IN North America the sovereign remedy for snake bite is whisky, prescribed in large doses. A more extraordinarily wrong procedure could not well be devised. Thorough-going experiments have shown that alcohol in small doses increases the rapidity with which snake poison is absorbed by the body, while in larger doses it very rapidly becomes an active aid to the snake poison, weakening the heart action when it most requires stimulation. The great majority of North American snakes are entirely non-poisonous. Several of the larger species, however—the common black snake and the large water snakes for example—are even more aggressive and more likely to bite than their poisonous brethren, a fact well known to most naturalists from personal experience. Such bites invariably heal promptly, without the slightest local or general symptoms of poisoning. To the great majority of people, however, all snakes are alike poisonous, and whisky has undoubtedly often been administered for the bite of such non-poisonous snakes. The patient, being less likely to die from the whisky alone than from the combination of whisky and snake poison, has a good chance of recovering in such cases. This chain of circumstances forms the foundation of the popular faith in whisky as a remedy for snake bite, although it must also be admitted that the belief is one willingly entertained by many.

The application of scientific research, beginning with the work of Pasteur, has developed the only real specifics against snake poison in the modern anti-venins. By their use, for example, the fatalities from snake poisoning in the Brazilian state of São Paulo have been reduced from the record of 155 in 1907 to two or three in 1924. Unfortunately it has been found that specific anti-venins must be prepared for each species, or at least for each group of related species, of poisonous snakes; and this increases vastly the difficulties of treatment by this means. A North American anti-snake-bite serum has just been put on the market.



TEXAS DIAMOND BACK RATTLESNAKE
An extensive folklore has grown up about rattlesnakes. The text describes many widespread and erroneous beliefs

The most characteristic poisonous snakes of North America are the rattlesnakes, and an extensive folklore has grown up about them. Quite the most common belief about rattlesnakes is that their age may be told by the number of rattles they possess. This is true when the rattle is complete with the original button with which the snake was born, although the number of rattles varies with the amount of food taken by the snake, and certain other conditions, so that the average figure, three rattles per year, is subject to individual fluctuations. A rattle is added every time the skin is shed. When the snake is full grown the rattle is rarely complete. It is widely believed that rattlesnakes when confined, and especially if tortured, will strike themselves and thus commit suicide. All available information, however, indicates that snakes are immune to their own venom, and in experiments I have made personally, causing a rattler to bite himself, there was no visible effect. There is a foundation for the story in that a snake, if sufficiently excited, will lash out in every direction and may then catch his fangs on one of his coils. The blow snake, when going into the convulsion preceding its death-feint, frequently catches its fangs on its own body.

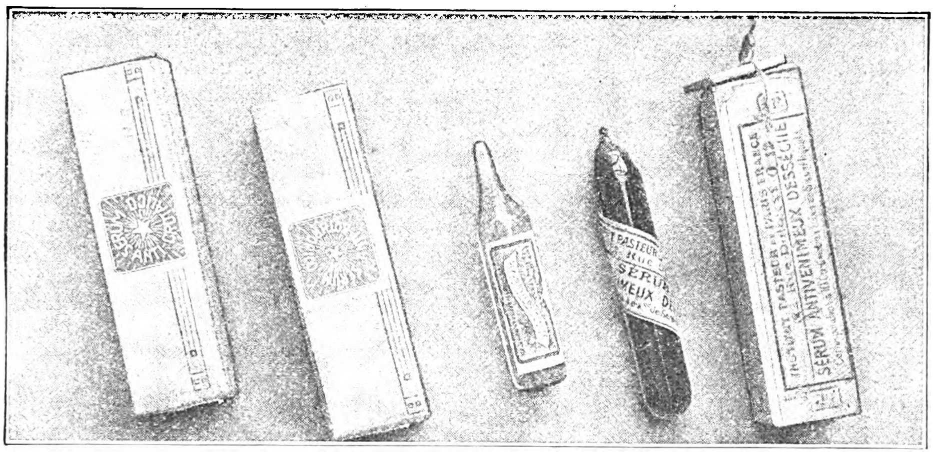
The common belief in the southwest that rattlesnakes will not cross a horse-hair rope (or even a chalk-line!) also seems to be without foundation. One of the widespread beliefs about rattlesnakes in the west concerns their presence in prairie dog colonies, where they are said to live in peace with prairie dogs and burrowing owls. The peacefulness of this relation is certainly open to question, in view of the rattlesnake's fondness for small mammals as an article of diet.

BY far the most characteristic North American rattlesnake fable is an elaboration of the fact that it is possible to be slightly poisoned by the venom in a broken fang. The story goes that a man is bitten by a rattlesnake and duly dies. His infant son grows to manhood and, finding in the attic an old pair of boots which fit him, puts them on and mysteriously dies with the symptoms of snake poisoning. An infant grandson grows up and, finding an old pair of shoes about, puts them on and becomes violently ill, but recovers. Examination of the boots reveals the broken fang of a rattlesnake embedded in the leather. The number of generations in this story varies, but otherwise its general course is the same whether it is told in Florida, Texas, or California. It has recently been embodied in a short story. The amount of poison on the point of a fang is of course so small that fatal results are very unlikely.

In the joint snake story or the glass snake story, we are told of a curious snake which flies into pieces when struck with a stick. The pieces are said to reunite if one leaves them undisturbed. This extraordinary story has a more extensive basis in fact than most of the popular snake myths. The fact that the joint snake is not a snake but a lizard is obscure to the ordinary observer, since it is entirely limbless and so has a snakelike form. It is, nevertheless, easily distinguished from the snakes by the presence of eyelids and ear-openings as well as by its small belly-scales and long tail. It is the length of the tail that is important to the story. Most lizards are able to lose their tails without serious injury and in many lizards—among them the joint "snake"—this tail-losing ability is very highly developed. The tail breaks at a special breakage plane and the muscle bundles are so arranged that they expand and close the arteries, preventing the loss of blood. The tail, or the pieces of the tail, are furthermore endowed with a very active reflex motion which causes them to snap and squirm and jump so that they are very much more conspicuous than the lizard's body, which is engaged in making a quiet get-away. It is not true that the pieces will join together again but it is some compensation for the lizard that it is able to grow a perfectly satisfactory new tail.

---

*Reproduced by special permission of the Field Museum of Natural History, Chicago. Copyright.



ANTI-SNAKE-BITE SERUMS

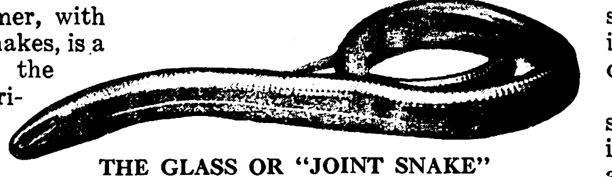
The best treatment for snake bites is serum, not whisky. Specific anti-venins are prepared for each species or group of related species. This increases the difficulty of treatment

In a fanciful American Indian fable the toad saves himself from his enemy, the snake, by the clever expedient of taking a stick in his mouth and facing his pursuer. The Indians, apparently, did not have the widespread belief in the ability of snakes to "charm" their prey. According to this belief, the snake's eyes so fascinate its victim that the unfortunate animal is made to advance toward the snake until it is drawn into the waiting jaws. It is possible that a small bird or mouse attacked by a snake might occasionally be unable to move from fright, but the behavior of mice when fed to caged snakes does not support even this hypothesis. Mice and rats invariably display the most complete indifference to the presence of a snake.

Snakes themselves, however, may be charmed in a somewhat different sense. The professional snake charmer, with his assistants and a stock of snakes, is a familiar figure throughout the Orient. Quite the most mysterious element in this so-called snake-charming lies in the apparent response of the snakes to music. "Deaf as an adder" is an old English adage, and the deafness of snakes in general seems to be supported by the most careful scientific experiment. In most cases, the swaying of the snakes in time to the music is due to the swaying of the body of the performer, and stops when he comes to rest. The snakes used in this practice are usually poisonous species, and the favorites are the cobras, which are preferred for their spectacular hood, their habit of raising the head and body, and their connection with Hindu mythology. Sometimes these poisonous snakes are defanged, sometimes their lips are sewed shut, and sometimes they are certainly *not* so treated, but remain in full possession of their poison-apparatus. It is likely that some of the professional snake-charmers are immune to the poison because of repeated small inoculations. An adequate study of oriental snake-charming from the scientist's standpoint remains to be made.

It is interesting that the removal of the poison fangs does not make a poisonous snake permanently harmless. The teeth of snakes are shed and replaced throughout life, and the poison fangs are simply teeth modified into hypodermic needles for the injection of poison.

Most reptiles lay eggs, but it is a curious and popularly much misunderstood fact that many snakes give birth to living young. In the reptile egg the growing embryo is nourished by a large food yolk. When the eggs are retained in the mother-snake's body, development takes place and eggs may be laid with embryos at various stages of advancement. In many snakes the development of the eggs in the body until the young snakes are fully formed has become the rule, and the young are then born alive. Since the young are nourished from an egg-yolk and not from the blood of the mother, this form of development is distinguished as ovo-viviparity.



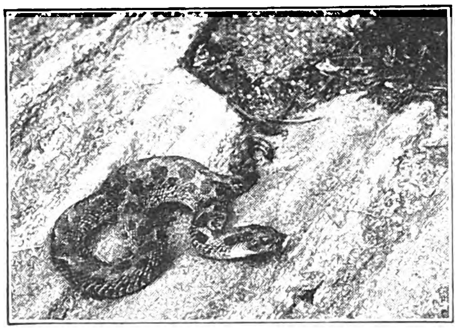
THE GLASS OR "JOINT SNAKE"

This so-called snake does not fly into pieces when struck; it loses its tail, but simply grows a new one

It is a widely held belief that the common aversion to snakes which amounts to violent fear in many persons, is instinctive in the human race. The evidence at my disposal leads me to the conclusion that this aversion and fear, when they exist, are wholly due to the example of an older person. I have never found any child who exhibited the slightest fear of snakes if he had not previously been frightened about them. On the average, in support of this observation, I find the fear of snakes much more frequent in older than in younger children. Anthropoid apes and, indeed, most monkeys, exhibit the same fear of snakes as is shown by man, but evidence exists to indicate that their fear is no more instinctive than the human.

Throughout eastern North America a snake is found which usually bears a most evil reputation. The number of popular names applied to it attest its abundance and many of them indicate its bad character. It is known variously as "hog nosed snake," "spreading adder," "blow snake," "blowing viper," and "puff adder." Terrifying tales are told of the way in which this snake actually blows its venom from a considerable distance into its victim's face, sometimes causing temporary blindness, sometimes convulsions. Although most of these stories are told at second hand, there is no dearth of actual eye-witness evidence of such poisonings.

As this snake is a common one in all sandy localities, there is no difficulty in checking up this reputation with actual observation of its behavior. In this case the facts turn out to be far more remarkable than the beliefs. As "Hog Nosed Snake" suggests, this species has a triangular flattened head, with a sharp-pointed and slightly upturned snout. The shape of its head corresponds well with the rough diagnosis of poisonous snakes as "broad-headed." In fact, when the spreading adder spreads the bones of its jaws at the rear of the head, as it does when alarmed, the head is pro-



BLOW SNAKE

Terrifying tales are told of this snake's behavior. He is a harmless "bluffer"

portionately broader than that of any rattlesnake. In addition to flattening and widening the head, the whole anterior third of the body is strongly flattened, and raised from the ground. In this position the snake faces its enemy, a more formidable looking animal than an Indian cobra of equal size. The lungs are filled with air, the middle of the body becoming twice its normal size, and if the intruder approaches the snake, it strikes and lunges viciously at him with open mouth and with loud hissing exhalations of the breath.

If one refuses to be frightened by this performance, advances upon the threatening reptile, and holds a finger within reach of its stroke, *it does not bite*. The stories about the poisonous nature of its breath are evidently fictitious, for no effect on nose or eyes can be observed. If picked up, however, the nauseous secretion of the anal scent glands is emitted, and to an already frightened person, this odor might suggest a poisonous breath. Detailed examination of the anatomy of this snake, as well as direct observation, proves that it is entirely harmless.

ANOTHER cycle of snake myths peculiar to North America relates to the hoop snake. The best-known version of these stories tells of a large snake that progresses by taking its tail in its mouth and rolling like a hoop. The tail is said to be provided with a venomous sting, and the snake capable of launching itself like a javelin, tail foremost, at an enemy. A wound by the tail-sting is almost instantly fatal, and the poison is so virulent that trees, accidentally struck by this snake, immediately wither and die. The force of its blow is such that a snake of this species has been known to strike its tail so violently into a tree as to be unable to disengage itself.

The background for this terrifying story is found in the much more widely held belief in a snake that stings with its tail, usually referred to as the "stingin' snake" or "horn snake." This, in turn, is based on the behavior of certain snakes which, when held in the hand or even confined with a stick, make exploring or apparently pricking movements with the tip of the tail. When, in addition, the tail ends in a sharp horny spine, some excuse is afforded for the belief in a tail-sting. The truth is, however, that no matter how much the tail of a snake may appear like a sting or even act like a sting, no snake has a poisonous or dangerous weapon in its tail. The elaborations of stories of a stinging snake into accounts of a snake that rolls like a hoop are of course entirely fabulous.

Two snake myths are apparently quite universal, the one to the effect that snakes—frequently some particular species—suck milk from cows, and the even more startling belief that young snakes take refuge in their mother's throat when alarmed or in danger. The two stories represent very different types of myths, the first being physically impossible, while the second is at least not impossible. It is not difficult to establish an hypothesis for the origin of the milk snake story. Cows are liable to sudden variations in milk flow from a large number of natural causes. This variation is a subject of importance to the cow's owner, and a matter of frequent observation, while the true causes of the failure of the milk to flow are often obscure and rarely observable. With this mental background, if a species of snake were found to frequent barns or pastures; and if an individual snake were to be seen to drink milk from the cat's saucer or to drink the milk leaking from a cow's distended udder, a casual connection between the presence of the snakes and the fluctuations in milk flow might be suspected. The snake most often credited with this performance, and known, in fact, as the milk snake (*lampropeltis triangulum*, in eastern North America), fulfills the requirement of frequenting barns; and as snakes all drink water, it is not at all unlikely that they would drink milk on occasion. For that matter the country people in India are said to set out a saucer of milk for the cobra which frequents their premises.

MILK SNAKE

Milk snakes never secured milk from a cow but they have robbed the cat's saucer

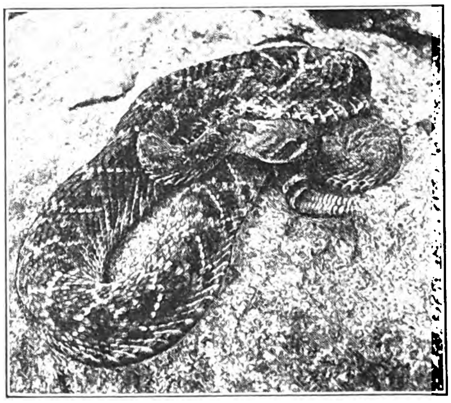
It has been suggested that some of the egg-laying snakes frequent manure piles and compost-heaps about barns for the purpose of laying their eggs. Most farmers, when they kill a snake, do so with such blind zeal and fury that little of the victim is left. The crushed eggs of a gravid snake would give forth a milk-like fluid, and this might be observed as confirmatory evidence for the belief in their ability to suck cows.

The ability of any snake to fasten itself to a cow's udder and suck milk must be considered a plain impossibility. If the six rows of needle-like recurved teeth in a snake's mouth were applied to a cow's sensitive teat, the animal would be driven into a frenzy, and the snake would be promptly dislodged by being kicked or stepped upon.

The attractive story that the mother snake receives her young into her throat to protect them from danger is apparently not physically impossible. The "snake-swallowing-young" story is supported by such plausible published accounts that even reputable herpetologists maintain, or endeavor to maintain, an open mind on this particular question.

IT has been objected that the young would immediately suffocate, or that they would be attacked by the gastric juices; but snakes do not suffocate very promptly, and there is a goodly stretch of gullet before the snake's stomach begins.

A second line of attack on the validity of this story rests on the possibility of a misinterpretation of perfectly correct, though hurried, observation. Many species of snakes, and among them the very ones to which the story is most frequently attached, give birth to living young. For several days before their actual birth these snakes are fully formed and capable of motion. As I have indicated above, snakes are commonly killed with brutal violence, and a gravid viper or garter snake or rattlesnake might then be seen to contain actual living young. An observer of the facts outlined above, especially if already familiar with the "snake-swallowing-young" story, would doubtless become an active witness for the truth of the belief.



A FINE RATTLESNAKE

Perhaps this rattlesnake can live with prairie dogs but the chances are not favorable for he is fond of small mammals

The Camel's Hump*

In It He Carries An Auxiliary Food Supply

By W. P. PYCRAFT, F.Z.S.

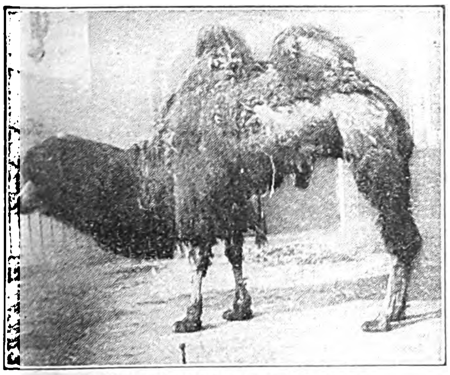
ONE of my correspondents wrote the other day to ask me whether the camel really does store water for his long desert journeys in his hump, or humps. There is a widespread belief that this is indeed the case. But it must share the fate of many other popular beliefs whose origins are untraceable.

The hump is really a reserve store of food, which takes the form of liquid fat, filling out a meshwork of tendinous, elastic tissue, comparable to the fat cushion on the head of the bottle-nosed whale. As the animals march, under the blazing sun, for days on end, this store is drawn upon until at last the hump assumes a flabby condition, a mere bag of skin and fibers.

And what is true of the Arabian, or one-hump camel is true also of the Bactrian, or two-humped camel in Asia. In the newly born calf, as is shown in the accompanying photograph of a young Bactrian camel, the humps are in the deflated condition, mere empty bags which will not fill out until the youngster can take solid food, and plenty of it, although I can find no record of the time taken to fill them.

What was the predisposing cause which brought about the storage of oil on the back, in humps, instead of the more usual form of fat on some other part of the body, as in other animals, is at present beyond us.

As touching the ability to store water attributed to the camels—they can indeed do this for times of stress; but it is carried, not in the hump, but in special cells or cavities of the stomach. These take the form of numerous chambers opening into the stomach, and attached to its under-surface in the form of a semi-circular belt. Most of these chambers open into the "rumen" or "paunch," but some into the "recticulum," or "honeycomb." For the stomach of the camels—which are ruminants—is composed of several inter-communicating chambers. In these animals, however, the compartment of the stomach known as the "psalterium" or "many plies," is reduced to a mere vestige.



EMERGENCY RATIONS

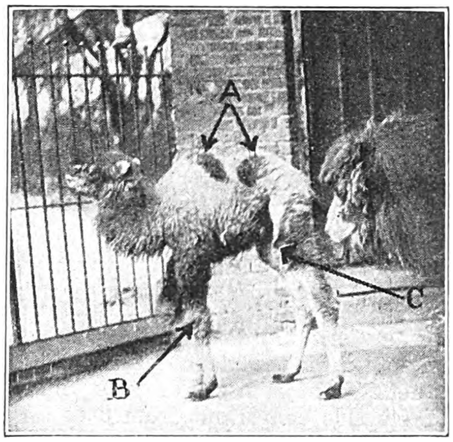
Adult, two-humped, Bactrian camel. Arabian camels have but a single hump

In the course of rumination, in the camels, the water swallowed is strained off from the solid food, and stored up for future use in these water-cells, which, when filled, can be closed by the contraction of muscles surrounding the aperture of each. As the march proceeds, the store, which amounts to nearly two gallons, is slowly drawn upon; but until these and the "emergency rations" of the hump are consumed, the animal can rub along without undue discomfort, although fasting, or with very little food. It does not seem to be generally realized that the stomach of the elephant is capable of storing a considerable quantity of water, although the elephant itself is not only well aware of the fact, but makes good use of it.

MY old friend, the late Captain F. C. Selous, in describing the chase of a wounded elephant, tells us that it would place its trunk in its mouth, suck up water from its stomach, and squirt it in refreshing showers over its shoulders and between its legs.

The Bactrian camel, it is to be noted, is one of the few animals which can, and will, freely drink salt water. On the Mongolian and Kirghiz steppes, indeed, it can get little else; and for its food it must contrive to subsist on the saline and bitter plants rejected by almost all other animals. Both this species and the Arabian camel contrive in some mysterious way to munch, without the slightest discomfort or injury to their mouths, the thorniest of branches, for the sake of such nourishment as they will yield. Desert plants, indeed, of whatever kind, are invariably more or less thorny. But the Bactrian camel is not necessarily a vegetarian. At need he will eat anything he may come across, including felt blankets, bones and skins of animals, and fish!

By some strange perversity the Bactrian camel is nearly always called the "dromedary." But this term should rightly be restricted to the lighter, and swifter, breeds of the one-humped or Arabian camel. But this by the way. By whatever name we call them, it must be admitted that they are ungainly-looking animals. This is partly due to the "tucked-up" condition of the abdomen, which exposes the whole length of the thigh-bone, a feature seen in no other quadrupedal mammals. But when we come to examine the legs of these animals a little closely, we find some extremely interesting relationships between structure and habit. On the true knee-joint, answering to the "stifle-joint" of the horse, there is a thick, horny pad; another is found on the wrist-joint—usually called the "knee;" and yet a third is found on the breast. These are all points of contact with the ground while the animal is at rest, and they have been developed in response to the hardening of the skin by the weight imposed. The fact that these pads are present in the newly-born camel, before ever it has rested after the manner of the adults, has been used as an argument in support of the theory of the "transmission of acquired characters," and that interpretation is surely justified, although it has probably required an immense number of generations for this transmission to be effected. Finally, the country of origin of the camels, whether of the Bactrian or the Arabian type, is unknown, for there are no really wild camels anywhere in the world; the "wild camels" living in remote parts of Turkestan are probably "feral"—that is to say, they are the descendants of animals which had escaped from captivity. Since the more primitive camelidae are all found in the New World, it is probable that camels, as we know them, came into being there and, migrating to the Old World at some remote period, became subjugated by man.



A BABY CAMEL

Its incipient humps at A are mere empty bags which hang over one side of the back

---

*Text and photographs courtesy of *The Illustrated London News*

The Puzzle of the Major Planets

Jupiter, Saturn, Uranus, and Neptune, Formerly Thought to be Hot, Are Now Suspected of Being Extremely Frigid, With Oceans Frozen Solid Thousands of Miles in Depth

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE heavens are still full of puzzles, and some of them cease to bother us only because we have long been almost ready to give them up. One of these old riddles has to do with the major planets—Jupiter, Saturn, Uranus, and Neptune. What are they made of? Can we answer this question at all, and what reasons can we give for our reply?

No direct answer is possible. We must proceed by collecting all the information that we can, and then see what sense we can make of it. There is a good deal of information to be had, but some of it is perplexing. At the very start, for example, we know the masses of the planets, which can be found with great accuracy by means of their attraction on their satellites; also their diameters, which can be directly measured with the micrometer. Combining the two we can determine the mean density of the planets' material. For the inner planets this comes out from 3 to 5½ times that of water, convincing us that they are of solid masses of rock mingled, perhaps, with metal.

BUT the densities of the outer planets are surprisingly low. For Jupiter we find 1.34 times the density of water; for Uranus about the same; for Neptune a slightly greater value; and finally for Saturn a density less than that of water—only 0.71 times as great.

These values are comparable with the densities of stars, not of solid bodies. Jupiter, Uranus, and Neptune are all about as dense as the sun, and Saturn only half as dense. Now there is no difficulty in explaining the sun's low density. It is intensely hot, even on the surface, and terrifically hot inside; the expansive force of the heated gas in the interior keeps it from collapsing under the enormous weight of the overlying layers. But can we apply this reasoning to the planets?

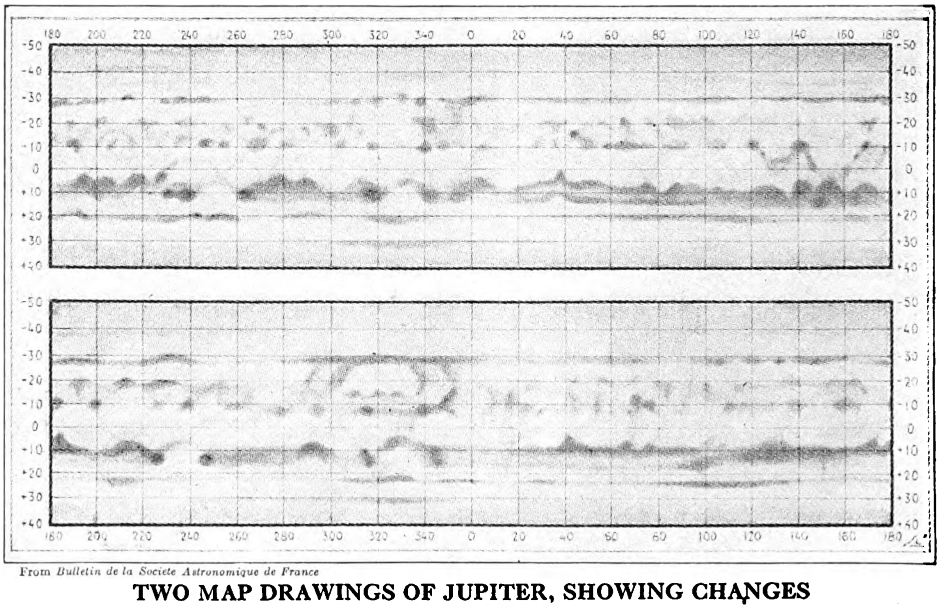
Until a decade or two ago this was supposed to be legitimate, and the older textbooks suggest that Jupiter may be hot inside, and even hot at the surface—although not quite red hot. The rapid changes of the cloud forms on its surface were attributed to boiling up of the heated material from below. But this theory died a sudden death when the radiometric measures at Flagstaff and Mount Wilson showed that Jupiter and Saturn gave out practically no measurable heat on their own account. A surface at the temperature of boiling water or even of freezing ice would send out enough heat to be easily observed, and it is generally agreed that the temperature of the visible faces of these planets must be more than 100 degrees below zero—the measures point to about 150 degrees below the centigrade, or 240 degrees below the Fahrenheit, zero.

This is not inconsistent with the rapid changes of the cloud-like markings on Jupiter's surface, for there are substances which boil at a very low temperature. Oxygen and nitrogen, for example, would condense into clouds as white as our familiar clouds of fine water drops at temperatures of minus 183 and minus 196 degrees, centigrade, at standard pressure. It is doubtful whether the atmospheres of Jupiter and Saturn are cold enough to allow this, but it is likely to happen on Uranus and Neptune unless the internal heat keeps their surfaces a good deal warmer than the sun's radiation can do.

But there are plenty of other substances, such as carbon dioxide, for example, which would form clouds at the probable temperature of Jupiter. If these substances were present in but small proportion in the atmosphere the clouds might evaporate and form again at temperatures far below the normal boiling points, as happens with clouds of water drops or ice crystals in our own air. Most substances of low boiling point are, however, colorless even in bulk, and would form white clouds. The pronounced and varied colors which appear on the surface of Jupiter, and to a less degree on Saturn, are therefore still unexplained.

It is tempting to think that the colors may not belong to the clouds themselves, but only to the many miles of overlying atmosphere through which the clouds are seen. But this as yet helps us not at all in identifying them. It should be remembered that our observations of the familiar gases at very low temperatures or in the liquid state have dealt only with thicknesses of a few inches.

WHAT would happen if we could cool a tube half a mile long with liquid air, fill it with various gases and pass light through it, is still unknown, and it may be that until someone meets the heavy expense of such an experiment we will not find out what the atmosphere of Jupiter is made of.



From Bulletin de la Societe Astronomique de France

TWO MAP DRAWINGS OF JUPITER, SHOWING CHANGES
Upper drawing shows appearance of planet early last November; lower one at end of same month. Made by Jacques Camus, with a 6½ inch telescope magnifying 250 diameters

One would naturally turn to the spectroscope for aid, but it only adds to our puzzlement by revealing a series of bands in the yellow and red which are increasingly prominent as we pass from Jupiter to Saturn, Uranus, and Neptune. In the last-named planet they are remarkably strong and probably account for the conspicuous green color which shows when observed visually. But no one has yet been able to match these bands in the laboratory, and we are in utter ignorance of what produces them. They are hazy and profuse in character, which suggests that they are produced in a gas of considerable density. Their steady increase of strength in the outermost planets, which are doubtless the coldest on the surface, has led Menzel to suggest that they are due to some compound or allotropic form of an element which is stable only at very low temperatures. For an atmosphere no colder than Jupiter's this compound would be almost completely decomposed by the heat (at 150 degrees below zero!), and only in the very cold atmosphere of Neptune would it be present in quantity. Here again we have to wait experiments at very low temperatures and on a huge scale.

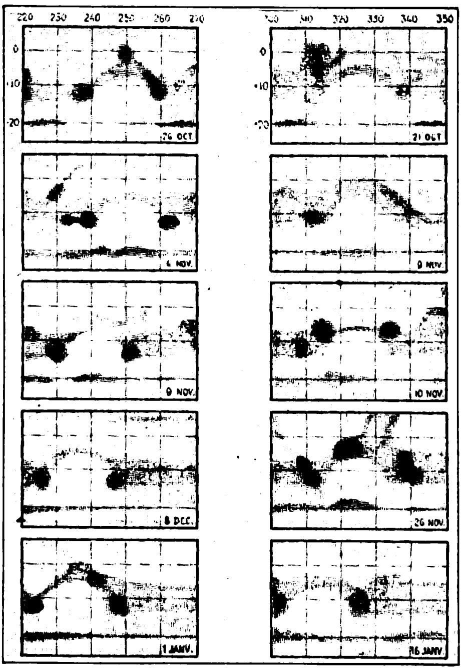
ANOTHER explanation has been given by Professor McLennan, who attributes these bands to the presence of ice on the planets' surfaces. But there are difficulties about this view and it is not generally accepted.

With so much uncertainty about the surfaces of the major planets, how can we hope to draw any conclusions regarding their interiors which we cannot even see? If we knew nothing more than the mean density of the whole mass we should be in difficulties, but we have another string to our bow.

All these large planets are in rapid rotation, and the rotation makes them oblate or flattened at the poles. Now the attraction of an oblate planet is not quite the same as if the mass were spherical, and this has effects upon the orbits of its satellites. These are always slightly elliptical in form. For a spherical planet the nearest and farthest points of the orbit, and the line of apsides which joins them, remain fixed in position. But in the case of an oblate planet this line rotates slowly forward in the direction of the satellite's motion. The greater the oblateness of the planet the faster is this motion. However, it is not the shape of the planet's *surface* alone which settles this but a sort of average of the oblateness of all the inner layers of the planet, even down to the center. For a nearly homogeneous planet the inner layers are about as much flattened as the outer, and the effect is relatively large. But if the density is much greater at the center than at the surface, the inner layers are less flattened than the outer and the average effect is diminished.

In this way it has been found from a study of the satellite orbits that all of the major planets are much denser at the center than near the surface. An effect of the same kind, but smaller, is found upon the earth where we know that the central density is four times that of the surface rocks. For Jupiter the disparity must be much more marked, and for Saturn greater still.

Now the planets were probably all produced by ejection from the sun, in the same great catastrophe, and should have been initially of similar composition. But this need not have remained the case after they solidified, for the smaller masses, like the moon, have not gravitation power enough to keep the lighter materials, like two permanent gases and water vapor, from diffusing away into space; while the larger planets can hold them all. It is natural, then, to suppose as Moulton suggested many years ago, that the major planets have retained great quantities of lighter materials which the earth and the smaller planets lost.



From *Bulletin de la Societe Astronomique de France*

TWO OBJECTS, ENLARGED

At left, a series of changes of object near 235°, in upper drawing on opposite page. At right, similar changes at 325°

What these substances were is indicated by recent studies of the solar spectrum, which show that the sun's atmosphere contains a large amount of oxygen, a good deal of helium and above all a very large proportion of hydrogen. This suggests that a planet like Jupiter, when it is cool, may be composed of a rocky core similar to the mass of the earth, covered with a vast mass of water—enough perhaps to form an ocean thousands of miles deep and veiled with an atmosphere of great extent, composed largely of hydrogen.

To what extent such a huge mass as Jupiter has actually cooled down is problematical. Jeffreys has shown that so long as a free circulation of liquid or gaseous material carried heat from the depths to the surface, cooling would be rapid. If once, however, a solid crust formed upon the core, or a mantle of ice upon the ocean, heat would be lost by the much slower process of conduction and the surface might cool to a very low temperature without any change in the deep interior.

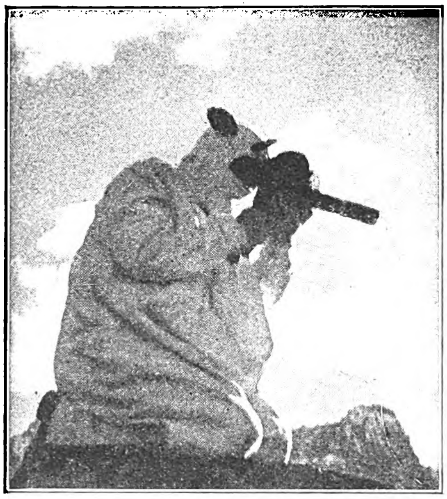
Working on such assumptions he has shown that the known facts can be accounted for by assuming that Jupiter has a rocky core (of density three times that of water) 57,000 miles in diameter, covered by a layer of water—or perhaps ice—11,000 miles deep, with an atmosphere of small density 3500 miles thick, extending out to the visible surface. For Saturn the diameter of the core comes out 32,000 miles, the depth of the ocean 11,500 and the thickness of the atmosphere 8000 miles.

THESE figures are very rough, for no allowance has been made for the increase of density of both the core and the ocean, due to the enormous pressure to which they are subjected.

In the earth's atmosphere the density doubles for a descent of about four miles. With an atmosphere of similar composition, but with the lower temperature and greater surface gravity of the major planets, the increase would be much more rapid and unless the temperature increased rapidly at greater depths the gas at a depth of a hundred miles or so would be compressed to a density almost as great as that of the liquid into which it would condense at low temperature.

A thick atmosphere composed mainly of oxygen or nitrogen on a thoroughly cooled planet would therefore throughout its lower part be about as dense as liquid air or as water, and Jeffreys' calculations would automatically add the thickness of this part of it to that of the ocean. Since his figures show that the upper part of the atmosphere for a depth of thousands of miles must be of much lower density, there seems no escape from the conclusion that it is composed mainly of hydrogen or helium. Liquid hydrogen has a density of one fourteenth, and liquid helium one eighth, that of water and these gases even under enormous pressure would become no denser than this.

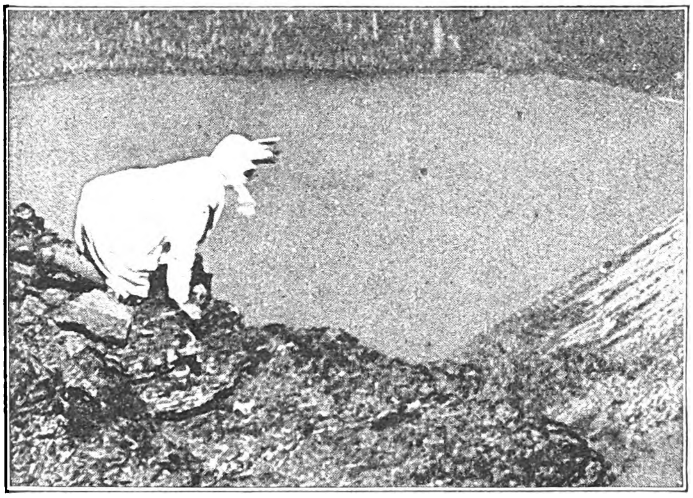
It is reasonable to suppose, therefore, that a huge, cold atmosphere of hydrogen, and perhaps helium too, overlies the surfaces of these planets.



Shooting Wild Life With a 'Movie' Camera

Goat Costumes and Improvised "Blinds" Enable Scientists to Obtain Interesting Records of Animals in Their Native Haunts

By ARTHUR NEWTON PACK
President, American Nature Association



All photographs by William L. Finley and the author

"THERE HE IS"
Off on the opposite side of the ravine is a wary mountain goat, scrutinizing the vaguely goat-like figure crouched on the hilltop

"WHAT'S THAT THING?"
William Goat can hardly believe his eyes when he sees William Finley, garbed as a goat, operate a camera with his "front feet"

◀ GOING DOWN
A telephoto lens caught the movements of this old billy as he sprang down

ON a rocky pinnacle far above the glacier is a white figure. From its head stick two black horns. Its white whiskers toss in the breeze. What seems to be a shaggy coat is ruffled by the wind. In this, a mountain goat country, it must be none other than a mountain goat. But something is wrong. Sure of foot as are these white inhabitants of the crags, none has yet been seen to stand poised on its hind feet and gaze intently about it. And when this odd animal reaches one foreleg into its ample bosom and draws forth an irregular black thing with a longish snout, any watching and wondering mountain goat—or uninitiated human, for that matter—might be expected to flee or investigate.

This was no strange goat hitherto unknown to science. It was merely Bill Finley trying to act like a mountain billy for the benefit of the bona fide billy goats of the upper reaches of Glacier National Park. The year before, our expedition had successfully filmed mountain sheep, elk, beaver, many small mammals, and mountain goats. Bill Finley, however, has devoted the last 30 years of his life to taking pictures of the wild world where it is wildest and knows what he wants to get. We had not been satisfied with our first year's films of mountain goats, so when Bill turned up for the second expedition he had with him something new in goat-getting equipment.

IT was like a glorified white flannel nightie, this grotesque affair, gathered in at the legs, adorned with a pair of flapping ears, quite presentable horns, flowing beard, and with a face-opening like an ancient suit of armor. He had kept the device a secret from the rest of us until we had worked our way into the goat country. Then he clambered into it while the rest of us suffered from pangs of laughter necessarily smothered because we had spotted some goats. Sticking the camera into the loose bosom of his circus suit, Bill declared, "I'm going to be as goaty as the goatiest goat. I'm all set but the smell and thank heaven for a head wind. Here goes."

Down the mountainside the bogus

ON THE JUMP ▶
Bounding across the camera's field, this deer served as a graceful artist's model

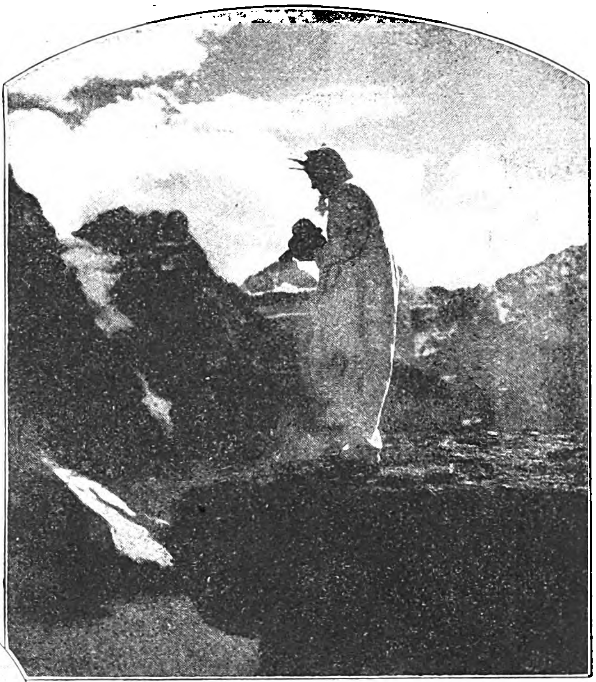
goat dropped, clambering in the direction of the real billy we had located on a crag a perilous but not considerable distance away. It was not long before the real billy spotted this apparition and paused to sniff the air. It revealed no taint of man smell so he continued grazing on a sparse outcropping of green. Bill, also, stopped to "graze," then moved on. Billy looked again, somewhat more puzzled but still not greatly disturbed. He kicked away a few small rocks and lay down on his craggy niche. Bill tried the same thing, not quite as nonchalantly, perhaps, since this cliff-dwelling business is more in the line of the rightful inhabitants, but the act went over.

THE short calm brought reassurance and Bill tried some more nearby grass. Billy got up, waggled his ears, and actually looked worried. Still Bill got nearer. Billy, puzzled, lay down again. On ambled the bogus goat. One hundred feet now! Suddenly the fore-hoof of this weird goat disappeared into its stomach, and from the black box and tube that it brought forth came a terrible buzz. No friendly goat had ever buzzed at Billy like that, and his knowledge of "movie" cameras and their whirring sprockets was exactly nil. For a moment he paused, a look of supreme wonderment on his face, like a child who has seen its first choo-choo train go thundering past. Then away, fleeing from precarious crag to dizzy cliff-edge, down what seemed like the sheer side of the precipitous mountain, away toward the Arctic Circle.

Upright now, camera under one arm, the bogus billy picked his way back. Planting one hoof on his voluminous whiskers and the other behind an ear, he opened wide his face.

"Well, that's one goat that's got," said Bill, as he stuffed a most ungoat-like bacon sandwich into his mouth.

We continued to work in this vicinity and the goat costume served well. We all tried it with varied and amusing results. Apparently the news of this strange intruder—this weird creation of the god of goats—had not spread. We stalked nannies and played hide and seek with them behind great rocks and around ledges. We filmed mountain goats in groups and singly. We played upon a natural curiosity they seem to possess, a trait that often stills fear to a degree delightful for the wild life photographer. And later, when the films emerged from the developing bath and the prints were made and run through the projection machine, they were, indeed, high tribute to Bill's glorified nightie.



THE GOAT-PHOTOGRAPHER

Above: Mr. Finley as the strange goat with a camera; and *left*, Mr. Finley when an ordinary human being

Goats, however, were not our only goal. On "movie" hunting expeditions of this sort into difficulty country, where wild life is really wild, one must learn the places where what one seeks may best be found. Often the first visit serves only to chart the way, to yield enough good "shots" to whet the appetite for more and to make the second visit more richly productive. This was true of our Glacier Park expeditions.

On our first trip we had found a favorite lake for beaver, where these busy fellows build dams much to the annoyance of the rangers. A dynamited dam only temporarily released the water because a few days found the barrier as strong as ever. In the fading light of the long mountain day we had gotten some rare shots of Pa Beaver dragging saplings back to rebuild his shattered dam. So back we went this time and met Pa and Ma and most of their relatives. We photographed them at their work. We took them to camp with us as overnight guests and filmed them fore and aft, paddle-like tail to efficient claw, and sent them back to their families with a thrilling tale that must have enlivened many a quiet winter evening in local beaver circles.

CURIOSITY

SURE-FOOTED

Venerable patriarchs of the mountains, these billies display much interest in the photographer's costume

MANY birds and small mammals posed for our whirring cameras. Deer and bear, protected in a National Park, proved friendly and investigated our camp. In fact one bruin proved entirely too friendly, and while some excellent films were made, our larder was depleted by a destructive and undiscriminating bear appetite.

Then we found a mineral lick and there got our pictures of that most beautiful and stately member of the deer tribe, the American elk, or wapiti. Patience and planning, the two essential ingredients for the wild life "movie" pudding, brought results. After a couple of days of stalking and studying, our party of four divided. Two of us worked down the creek below the lick where tracks showed where the wapiti crossed the stream on their way to the lick. Each took a side of the creek to be sure that one or the other got results and waited for the others to inspire the deer to leave the lick and go back along the trail.

Almost before we were set we heard

the pounding of hoofs and the crash of running elk on the hillside. Hardly had we gotten out of the trail and our ready cameras up than three cow elk came down the slope leaping logs and underbrush with glorious lack of effort. Past they went, dashing the creek into showers of glistening spray. A calf clung close to its mother's flank and all paused in mid-stream as the woods sounded with another crash. Past us went a great, antlered bull. Leaping lightly over a fallen log, he landed in the stream and they were all soon lost in the dark of the trees. With us, however, they had left the story of their passing in all its graceful detail.

Both Bill and I had gotten them and were shouting to compare notes when another band of wapiti came tearing by. Some find a thrill in placing a bullet so that it will bring such glorious animals down that their antlered heads may be mounted in some hunter's den. For us there is a far greater thrill in the more difficult sport of carrying home on the film the true story of such an animal in all its free, wild beauty. It is far more soul-satisfying to us to live over the thrill of the moment as it is revealed on the screen than to gaze at the glassy-eyed stare of a mounted head.

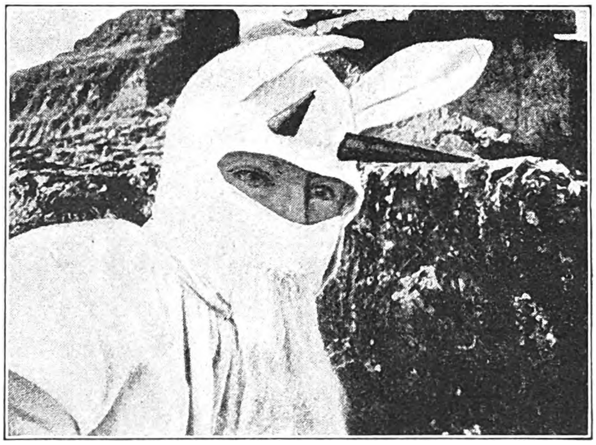
FOUR LEGGED?

Poised on a rock, beard waving in the breeze—a strange sight for the billies

It was not the stirring experience of "shooting" our wapiti or the amusing subterfuge with our mountain billies, however, which supplied the biggest event and the greatest pictures on our last trip. We were out to get moose on this camera hunt and get them we would if we could find them and lived. Moose there were, but there were moments when our continued existence was a matter of doubt—to us, at least.

"Moose? Sure," declared Scotty, the fire ranger at the lookout station above Bowman Lake. So we camped there and waited for Scotty to produce and to report sight or trace of these big-antlered fellows.

While waiting we started campaigning ourselves. Not far back from the river channel we found a stagnant pool of foul water. It was ringed with tracks of moose. Enough for us, so on the little spit of land we built a blind among several small trees, laying boughs against these slender saplings. We settled down here but four mooseless days passed with only a few shots of mergansers, some ground squirrels, and a white-tailed buck deer or two. Scotty was fast losing our confidence when word came that moose were in the vicinity. Off we hurried, crept up to our blind and cautiously into it.


EARS, HORNS, AND ALL

A close-up of the photographer in his successful disguise, showing the opening for vision

Sure enough, across the river on the edge of the woods was a moose cow and her calf. The wind was toward us and she scented no danger, nor could the little clump of trees have looked much different to her. With her youngster she trotted down the opposite bank and into the river, straight toward us. Our cameras buzzed but their noise must have been drowned by the splashing water. Out on the near bank she came and toward the pool of muddy water. Some scent of danger must have reached here when she was less than 150 feet away because she veered off from the range of my camera but directly into Bill's. She performed beautifully for us, not 75 feet from Bill's buzzing film box, had a drink of muddy water and then trotted down stream, swam into deep water and disappeared on the other shore.

TRANSPORTATION FACILITIES

The cameras and equipment for the photographic expedition into the mountains were carried on pack horses

Jubilantly we lighted our pipes and told each other how blooming big the old cow had looked in our finders. In hopes we stayed on, but by five-thirty we were cold and about ready to call it a day. Some sandwiches and oranges decided us to try another half hour and hardly had we settled back to watch when the cow appeared again at the edge of the woods, looking straight at our blind. For some moments she stood like a statue except for a flick of her ear, then she turned into the forest again.

CRAWLING ALONG

Mr. Finley stopped at times apparently to graze, to allay the goats' suspicions

Hardly had the cow gone than there appeared on the opposite bank a grand old bull moose. The missus had made a report. He paused a moment and then plunged into the stream. The cow and calf followed in his wake. Then the fun started. While the old man came on directly toward the front of the blind, mother and child worked around behind us. I looked over my shoulder.

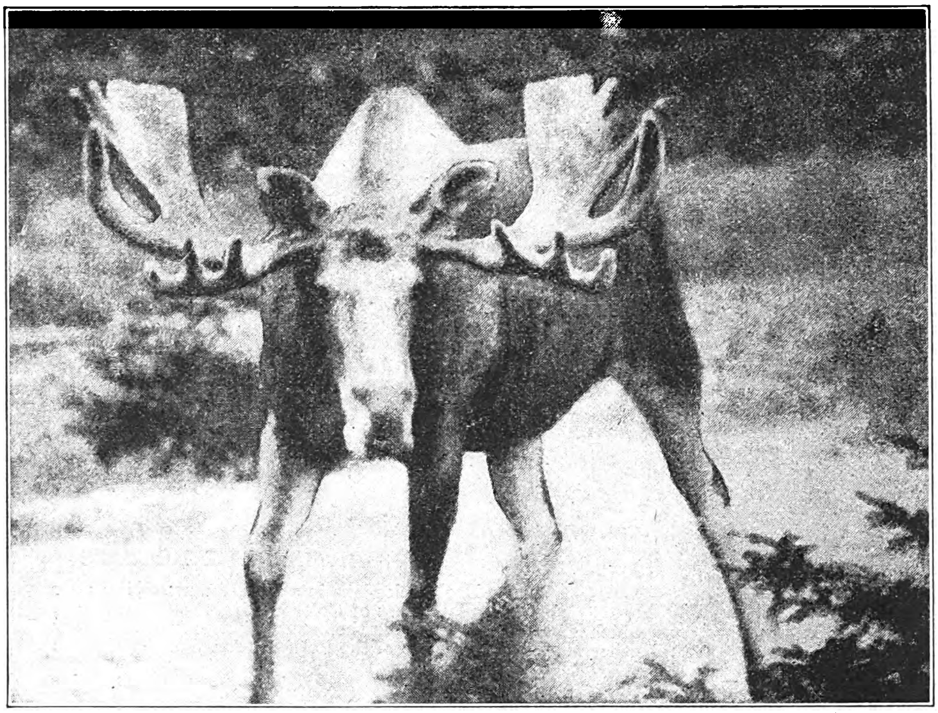
"Great Scott, Bill," I whispered, "the old lady's coming in the back way. She'll step on us and drive us out of here. We're surrounded by moose."

"Yep," said Bill, "Too much moose."

The old bull came on, straight at the blind. Twenty-five feet! Fifteen feet! What was in those trees, he didn't know. Should he find out? Should he charge with those great, powerful, murderous antlers and put a stop to that buzz? He must have been pondering something like this; and how we wished those slender saplings were foot-thick trees! Four cameras we had and through the sprockets of each the film sped until we must reload. It is a trick to stick your head into a loading bag and load a camera with a bull moose outside trying to decide on a charge and you with a fine case of buck fever complicated with fright. If you don't believe me, try it.

MOOSE

Many feet of interesting film were obtained from the shelter of a "blind." We reproduce here two frames of the thousands exposed



HEADED FOR THE CAMERA

The author and Mr. Finley spent many anxious moments in a flimsy blind when this huge bull moose seemed about to charge toward their frail shelter, but he changed his mind

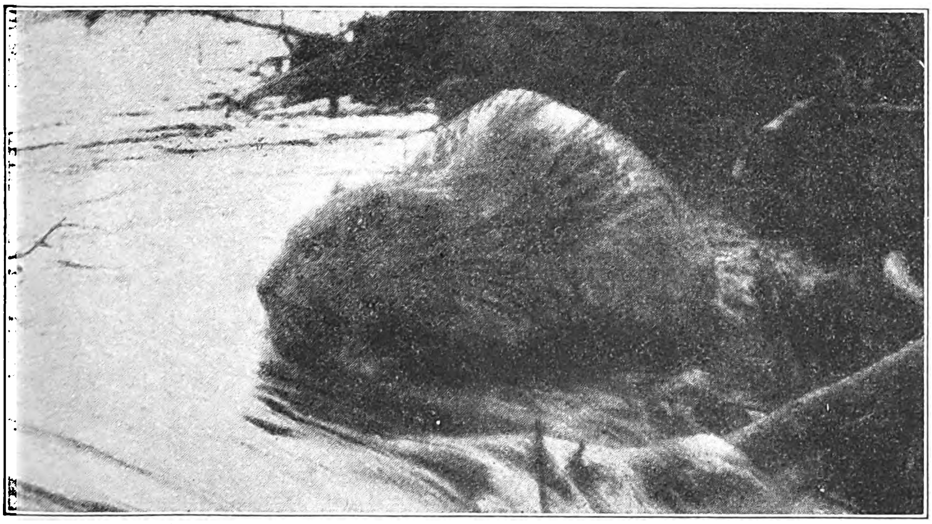
By some kind fortune the sprockets caught and I handed Bill the camera just as the big fellow decided to move a few feet to the pool edge to have a drink and think it over. He went down on his knees and drank fully. Then he rose and came back. Facing us so close that his broad antlers filled the finder to overflowing, he swayed his head back and forth. He grunted; and the next time I hear such a grunt I hope it's from behind zoo bars. He would go back to the pool and watch us, then come closer again. Once he raised his hind foot and scratched his ear. Comic relief!

The old bull went quickly back to character, however, and gave his antlered head another toss of truculent warning. He was now directly behind the blind and completely between us and the nearest shelter. How good those huskier trees looked as we peeped through our own slender saplings at that well-equipped head! In what spare moments I had between getting shots of my own and keeping a weather eye on the old fellow all of the time, I pondered on why he had not lowered his head and made a dive for the blind. There was, of course, the probability that he was loath to take any chances by barging in to destroy something he knew nothing about and which made noises new to his experience. It seemed certain that some such thought was in his mind for he was really angry, very likely at himself, in part, because he couldn't solve the problem to his own satisfaction. There was also the possibility that his antlers were still a bit tender and although the trees which shielded us were not such serious opposition to him, he did not care to risk a charge without good and sufficient reason. But the fact remained that there he was and there we were—and what to do!

Now Bill Finley is a brave man and wild-life wise. It struck him there was one way of saving our skins, probably at the expense of only one camera. Out of the blind he went, setting up one of the machines on a tripod. He figured the old moose would more likely charge the thing he could see and in the rush we could dive into the bushes to the right and left while the old boy kept on to the river. He glared and grunted at this new contraption.

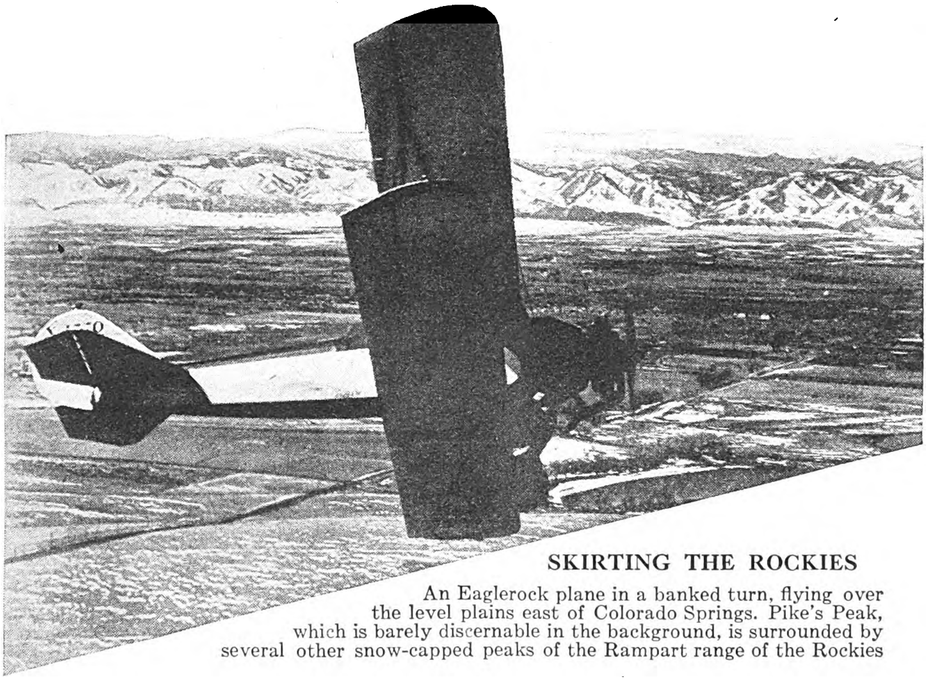
BILL'S camera started up with a buzz. I dropped the spool and loading bag and the moose turned my way, grunted and swayed some more. Bill's hundred feet of film gave out and he reached for the loaded decoy camera. The tripod clattered down and the bull for the first time showed fear. He moved off a few feet and, Heaven save him, Bill after him, buzzing as he went. Bill had figured the moose would have charged already if he was going to and there was larger timber not far away. It was clear the old fellow was angry but he didn't understand this business and therefore was somewhat afraid of it. Once he turned as though he had made up his mind, then grunted and drew off to the big timber. He disappeared, following his family that had gone earlier.

In that puny blind the old bull moose left three people who had had a big scare and a great thrill, and who sat among a clutter of camera equipment and sighed in unison. He also left 500 feet of movie film that had only one fault—it was so good that most people would declare it had been made in a zoo. It wasn't!



BUSY AS A BEAVER

Forest rangers dynamited a beaver dam, but the little workers went right back to work and the barrier was restored to its original strength only a few days later and the pond was full



SKIRTING THE ROCKIES

An Eaglerock plane in a banked turn, flying over the level plains east of Colorado Springs. Pike's Peak, which is barely discernable in the background, is surrounded by several other snow-capped peaks of the Rampart range of the Rockies

Learning to Fly From the Ground Up

Students in Flying School Study Design and Construction in Airplane Factory

BY H. CHASE STONE

Director, Pike's Peak Flying School

"LEARN to fly in high altitude and you can fly anywhere" has long been an accepted axiom in the aviation industry. Situated at the western edge of the great plains and overshadowed by the snow-capped peaks of the Rampart range of the Rocky Mountains, Colorado Springs has long been a favored site for a flying school. Another factor that contributed to the ability of the Pike's Peak Flying School to attract aviation students from all sections of the country is the presence here of the factory of the Alexander Aircraft Company. The opportunity to study airplane designing, construction, and factory management is an important consideration, particularly to students who intend to take up aviation as a vocation.

Our first group of students consisted, for the most part, of those interested in aviation as a sport and included polo enthusiasts, golfers, tennis players, and young business men. Some few of the students were interested in aviation as a career and followed their course of instruction with the purchase of planes to be used in commercial work.

The next group of students enrolling in our school was more promising. These were young men who intended to follow flying as a career. The group included youths from farms, from factories, and from middle-class families, who preferred to invest their savings in limited commercial flying courses, rather than a college course. Some of them were able to pay for flying time enough to secure transport licenses. It was with the enrollment of such a group of students that we decided to expand our courses. For the first time, we instituted a complete ground school course.

We found that "high altitude flying" and the opportunity to study airplane construction while learning to fly provided a combination eagerly sought by embryo aviators. Through the co-operation of J. Don Alexander, president of the Alexander Aircraft Company, the students of the Pike's Peak Flying School are received into the factory for instruction. The students of our school are given every possible bit of assistance here. They are transferred from one department to another as they show progress, and by the time they have completed their flying course they have secured a working knowledge of every phase of airplane construction.

THE students are first instructed in the rigging line, where the wings of the planes are attached to the fuselage and the ships are accurately rigged prior to being test flown. They gain valuable experience in this department and are firmly impressed with the value of accuracy in the rigging of airplanes. They are also taught to conduct a complete final inspection of a ship before it is to be flown.

When a thorough knowledge of the completed airplane is gained, they are started on a prescribed route through the factory, covering a period of several weeks, each phase of the work being explained to them by competent

PIKES PEAK AIR S CE CO. INC.
COLORADO SPRINGS
C 6304

OFFICIALS OF THE PIKE'S PEAK FLYING SCHOOL

The writer with Don Diegel (left) who is an instructor at the Pike's Peak Flying School and also chief test pilot for the Alexander Aircraft Company, makers of Eaglerock airplanes supervisors. Upon completion of the course, every student has a working knowledge of each phase pertaining to the manufacture and production of commercial airplanes.

This instruction in the factory supplements the course in flying, and leaves time to spend in the air. Appointments for flying time can be made during the day, and the student has only to walk about 300 feet across the highway to the 260-acre airport where the school planes are kept. As for the students who are regularly employed in the airplane factory, the flying school instructors make appointments from daylight until 7:30 in the morning when the shop opens, or after 4:30 in the afternoon when the factory closes, to enable these men to receive their flying instruction.

Students taking such a combination course have an advantage in the aviation industry of the future by reason of their dual knowledge of flying and airplane design, construction, and repair. Also, by working in the factory during their course of instruction, their day is completely taken up with constructive efforts for learning the complete science of aeronautics. We impress upon our students the value of observation, for much can be learned by watching and working beside an expert.

AVIATION STUDENTS WORKING IN THE EAGLEROCK FACTORY

Interior view of the fully equipped factory at Colorado Springs, where aviation students of the Pike's Peak Flying School receive instruction in aircraft design, construction and assembly, while learning to fly in the rarefied atmosphere more than a mile above sea level

ONE of our instructors, Don Diegel, is chief test pilot for the Alexander company. He tests every ship coming off the factory line. The students gain much from observing this type of work.

So far I have not touched upon the advantages of altitude flying. Colorado Springs is situated on a plateau at the base of the Rampart range of the Rocky Mountains, at the foot of Pike's Peak. The altitude of Colorado Springs is 6036 feet above sea level. The difficulties of handling a plane at this altitude have long been recognized by veteran flyers. The air is more rarefied and take-offs necessitate longer runways, and landings must be made at a greater speed than at sea level. To the flying novice who learns to get off the earth from an airport at more than a mile above sea level, and who learns his landings well at this height, there can be few difficulties wherever he may fly.

The rarefied air in the vicinity of Colorado Springs offered considerable difficulty the first year we were operating. At that time we were using Eaglerock planes powered with OX-5 motors. It was only early in the morning and late in the afternoon that the air was dense enough for these low-powered planes to get off the ground with sufficient safety for student instruction. During the middle of the day when the sun beat down on the airport, the air was so thin that the 90-horsepower motors could scarcely lift the planes. We decided to purchase more powerful planes and bought two Eaglerocks equipped with 150-horsepower Hispano-Suiza motors. These planes proved ideal for our purpose.

We next instituted the Rankin system of flying in order to secure a bona-fide ground school system, and we made a valuable connection with Colorado College, one of the oldest institutions of learning in the west, located in Colorado Springs. The college officials proved more than ready to co-operate, and loaned us several of their engineering staff as instructors in the various phases of ground school work.

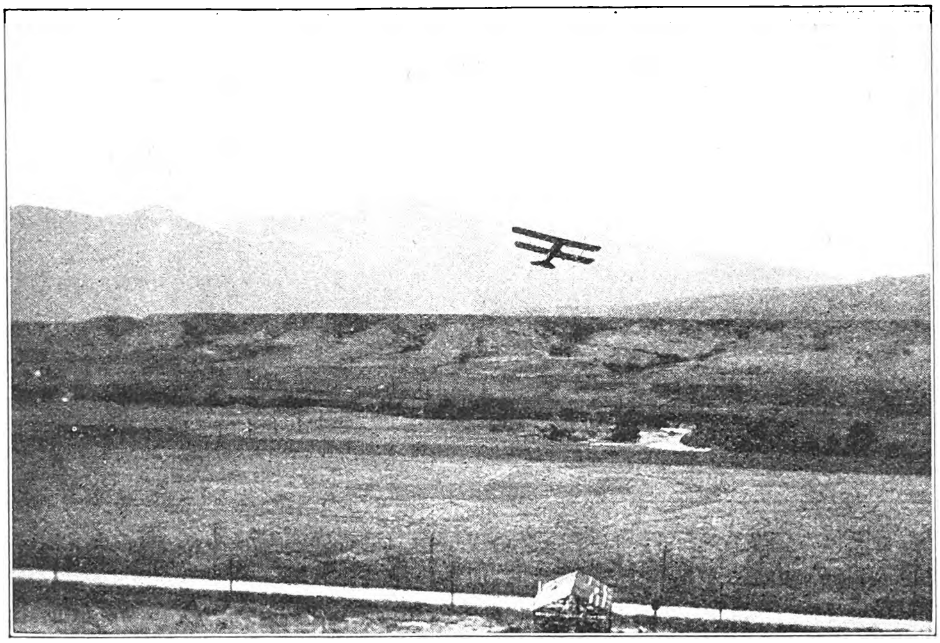
When a student arrives for enrollment in the Pike's Peak Flying School, he is first given about ten days ground school work before being permitted to take flying instruction. Following the completion of this ten-day course he is given a dual flight with Don Diegel. Immediately he is allowed to handle the controls in dual instruction. After a period of ten hours or more of dual instruction, he is permitted to take his first solo flight. Following this, he is allowed to continue to take the ship up alone but with periodic check hops by the instructor. These check hops are given to the fledgling in order that the instructor may correct in time any faults into which the student may have fallen.

THE primary student instruction is carried on out over the miles and miles of level plains lying to the east of Colorado Springs. Here the students can fly and land at will without the usual mental hazards that so often accompany the average student training, due to dangerous landing conditions beneath.

In the later stages of their instruction, the students are introduced to the peculiarities of the air conditions which sometimes exist around the mountains. The secret here of mountain flying is in retaining sufficient

FLYING ALONG THE EASTERN EDGE OF THE MOUNTAINS

Within a few miles of Pike's Peak and the Garden of the Gods, the embryo pilot has a magnificent panorama while accumulating the 50 hours in the air necessary to get a license



TEACHING BEGINNERS TO FLY IN HIGH ALTITUDES
Pilots accustomed to the atmospheric conditions encountered in high altitudes can fly almost anywhere, but those accustomed to flying at low altitudes are handicapped at higher levels

altitude at all times so that the upward and downward drafts have relatively little effect in relation to the mountains. In experiencing these sensations the students gain valuable experience in handling the equipment under difficult conditions. At all times while flying over the mountains, either on student work or passenger flights, the planes are within gliding distance of our airport. The safety of flying over Pike's Peak, which has an altitude of more than 14,000 feet, was demonstrated by us a few weeks ago. The motor of a plane was shut off while directly over the summit of the Peak, and the plane glided back to our airport with still a reserve of 4000 feet altitude.

During all this time the student is continuing his ground school course and is spending much time in the aircraft factory. When he has completed 50 hours of solo flight, a local inspector for the Department of Commerce gives the fledgling an examination. If the student passes the examination, he is issued a limited commercial license.

THE pilot then may continue his studies and obtain more flying hours, or he may procure his own plane to continue his hours in order to secure a transport license. Some of our graduates have taken up piloting of planes owned by individuals in order to secure the needed hours. Some of them, after graduation, "ferry" ships for the Alexander company; that is, deliver ships from the factory to the purchaser. In this manner they secure valuable cross-country experience as well as earn money, while flying the necessary 200 hours.

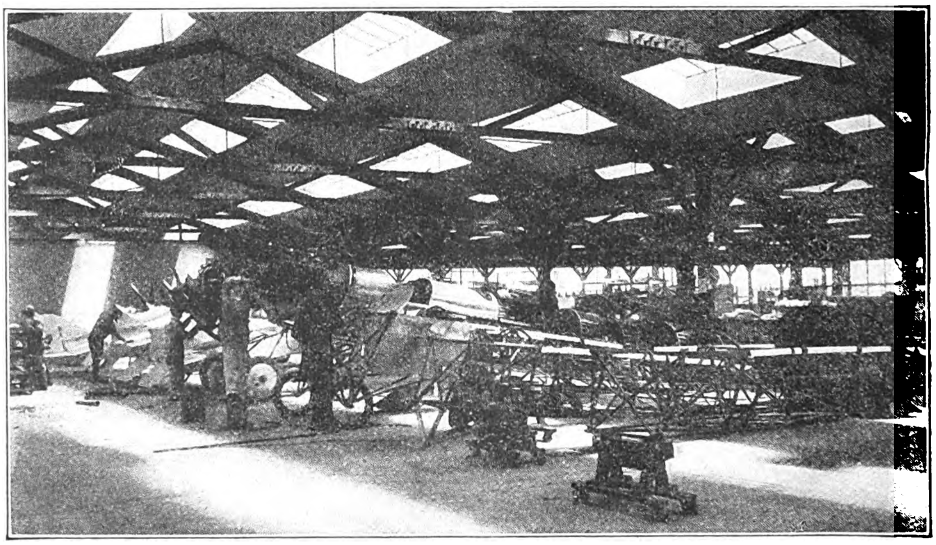
The fledging on his solo hops around Colorado Springs secures more knowledge of air currents than many veteran pilots have ever learned. During the Pike's Peak air meet, held in Colorado Springs in August, 1928, the chief attraction for the pioneer army and commercial pilots was the mountains. Virtually every pilot took his plane for short jaunts over Pike's Peak or some of the lesser mountains, just for the experience. All of them were surprised by the many things they learned concerning down currents and up drafts. They had all been taught these facts but had never learned them by personal experience.

It was also noticeable during the air meet that pilots who had never flown in high altitudes before had difficulty in taking off and in landing. Many of the army flyers who had thousands of hours to their credit would hang the plane by the propeller on taking off or stall into the airport on landing. They could not realize that high altitude necessitated a long take-off and high landing speed. The fast army pursuit planes, for example, which landed at Kelly Field, Texas, at 60 miles an hour came into the airport in Colorado Springs at nearly 90 miles an hour. For that reason larger airports have been constructed in cities situated in high altitudes.

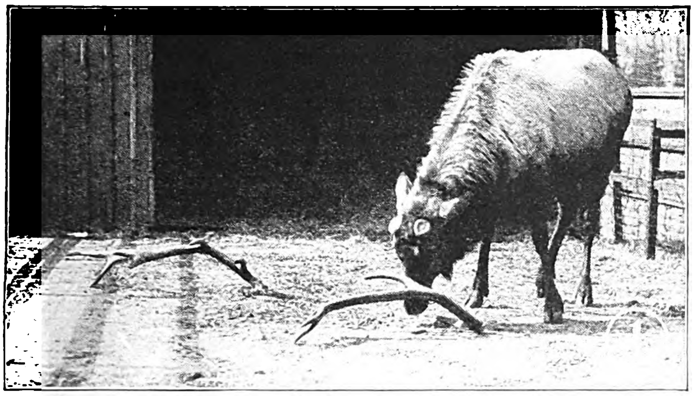
By the time the student is eligible to take an examination for a limited commercial license, he has flown over many of the nearby peaks and is undaunted by mountain flying. He is fully qualified to take a plane across the country.

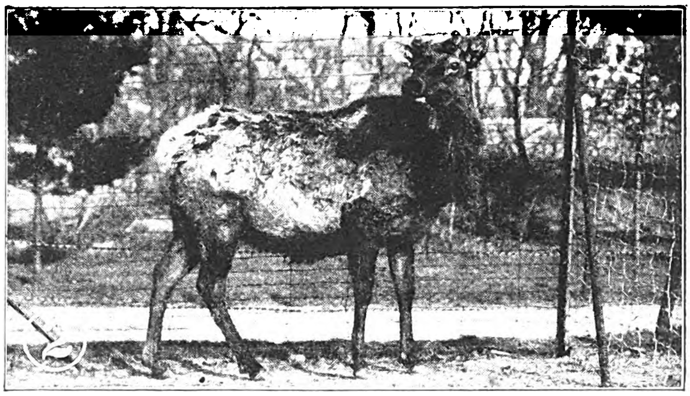
The chief spirit we have tried to inculcate in our personnel and in our students is that of "safe flying." We do not permit stunt flying by our students. Everything possible is done by the instructors and ground crew to eliminate recklessness on the part of students. Much of this spirit is due to the personnel of the school. Don Diegel is our chief pilot. The field manager is Lawrence Dettling, one of our first graduates who has remained as a pilot and chief mechanic. He will soon be promoted to chief operations officer of a scenic air tour company which we are starting. Stewart Wandell, although a competent pilot, prefers to be an expert motor mechanic and spends eight to twelve hours each day nursing the "Hisso" motors and making minor repairs on the planes.

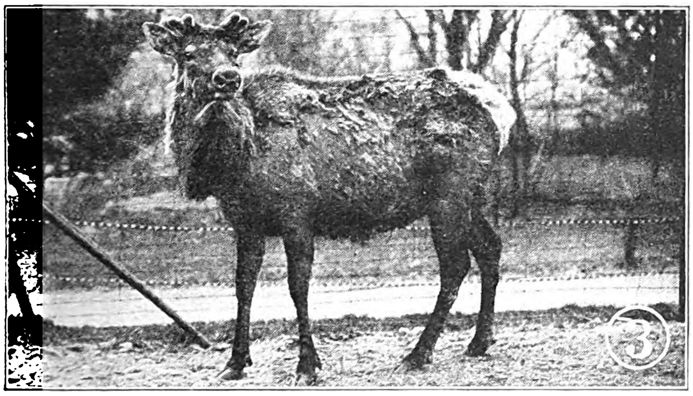
SEVERAL members of the Alexander Aircraft Company's sales staff are transport pilots and they assist whenever needed in instruction work and in passenger carrying. Two of these are O. R. (Ted) Haueter and J. A. McInaney. O. M. (Red) Mosier, a well-known cross-country pilot, will be the head of the newly formed scenic line and will give advanced instruction in aerobatics and cross-country work.

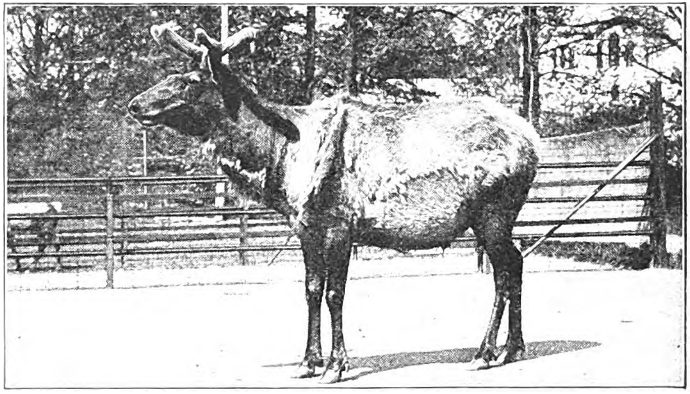


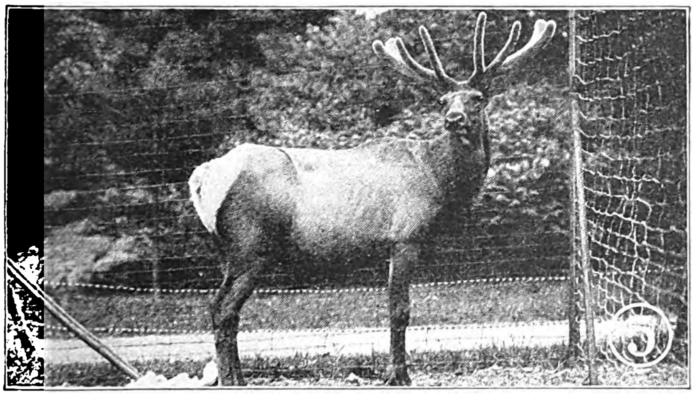
MOTOR ASSEMBLY LINE IN THE EAGLEROCK PLANT
Every phase of aircraft construction is studied by those enrolled in the flying school course; upon completing their studies many pilots with limited licenses "ferry" planes for extra hours

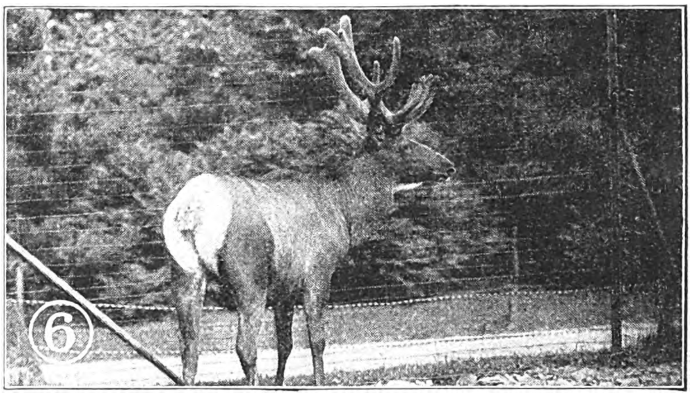


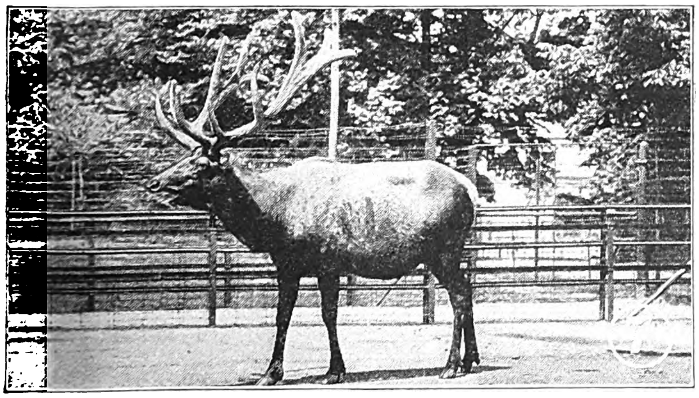


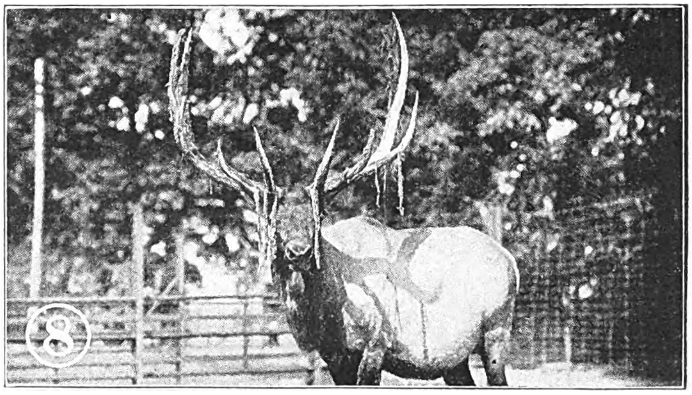






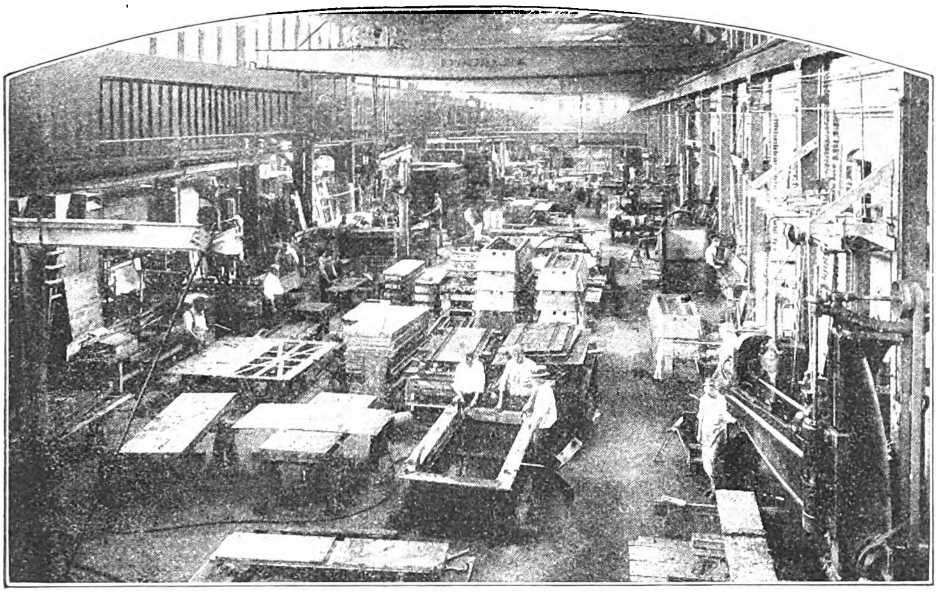






Off With the Old Antlers and On With the New

THE wapiti deer, now confined to the western part of the United States and portions of Canada, and erroneously called elk in America, sheds its antlers annually along with its winter coat and during spring and summer grows a full new spread. The interesting stages of this new growth are shown in the series of photographs on this page which were taken by Elwin R. Sanborn at the New York Zoological Park. Photograph (1) shows the wapiti just after the old antlers have been shed in March; (2) the new antler appears as a bud on the old pedicle and the winter coat begins to go, April 25; (3) the antlers grow fast and the branches appear, April 29; (4) the branching begins to foretell the pattern of final growth and the last of the hair is ready to shed, May 9; (5) the old coat is gone and antlers larger, June 1; (6) the thick covering of velvet makes the antlers look clumsy, June 25; (7) the full pattern is completed and the antlers harden in August; (8) the velvet is now dead tissue and the wapiti gets rid of it by rubbing against trees. Photographs and material courtesy the *Bulletin of the New York Zoological Society.*



VAULT FITTING FLOOR OF PLANT

The vault doors and vestibules come in at one end as rough steel castings. They pass from machine to machine until they are fitted with bolts at the other end of the room

Foiling the Burglar—II

The Time Element Versus the Burglar. A Continual Battle of Keen Minds

By A. A. HOPKINS

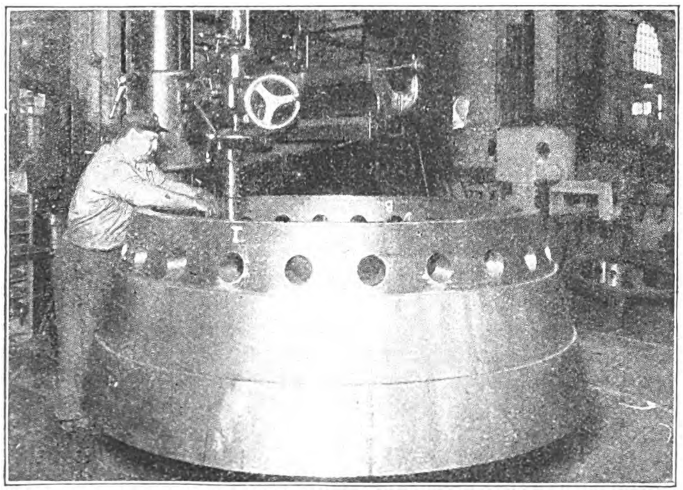
Author of "The Lure of the Lock."

IN our last issue we showed how man tried to protect his valuables, as secret hiding places had been found to be impractical. Another angle of the problem relates to the form of the container which was often an oaken chest, metal bound and locked with cumbersome bolts, and controlled in many cases by trick or secret locks. With the increase in quantity of valuables, we find the banker coming into the picture, for he, and only he, could assemble a number of chests in a strong room with thick walls, heavy doors, and cleverly designed locks which looked formidable even though their defense might be weak. This was the precursor of the modern vault which developed along two dissimilar lines.

First we have the "continental vault" and second the "American vault." The continental vault consists of a fireproof vault with little or no burglar-proof qualities, filled with a number of very strong and presumably burglar-proof safes. This is, in principle, a reversion to the plans of the Fuggers or other medieval bankers. (The continental vault designer will tell you that if an American vault is burglarized—if the lining has been penetrated or the door opened burglariously—the contents of the vault are practically at the mercy of the intruder, due to the fact that the containers inside the vault are not of extraordinary strength. He would say that this was putting all the eggs in one basket.) There are some exceptions for some governmental depositories abroad are veritable citadels, but the branch bank vault is ordinarily meant. Of course, our American theory is that, if we make the surrounding walls and the doors as strong as possible, taking into consideration the permissible outlay for any given job, we have protected the entire interior.

With the extreme thickness of doors, vault walls, et cetera, in this country, we are given so much more protection in the aggregate than would a number of safes contained within the vault, that we may consider this a better method of protection.

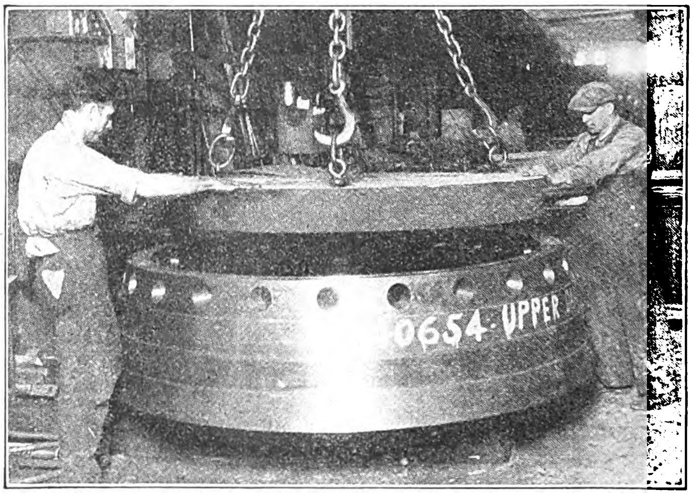
THE American vault differs in that the entire vault is not only fireproof but is made as burglar-proof as possible by the aid of the finest materials, impeccable workmanship, and the creative ability of the vault engineer. The masonry structure is usually of very heavily reinforced concrete. This is lined with heavy metal on all four walls, the floor, and the ceiling. The metal work is a combination of plates and angles containing open-hearth steel, drill-proof steel, and torch-resisting metal. The doors are massive structures of enormous thickness. They are commensurate in strength with the masonry work and lining so that together they make a burglar-proof room, the contents of which are amply protected. In practice, the American vault when constructed with extremely heavy doors and built with reinforced concrete walls, could withstand mob violence for a considerable period of time while the continental vault would



All photographs courtesy The Mosler Safe Company

ROUND DOOR IN THE MAKING!

This enormous door will protect millions in securities. It will have 25 round radial locking bolts. The door is being drilled



STRONGER THAN BURGLAR'S TOOLS

A drill-proof and torch-proof slab is here being lowered into the shell of the vault door. It is only one of several built-in layers not resist such a massed attack.

All this brings us to an important point which may be termed "time and the burglar." Given time and tools no vault is invulnerable. But power tools could hardly be used except under mob domination and a field piece to attack the walls of a vault is not usually a part of the burglar's equipment. The object of the vault engineers and the builders is to prepare a barrier which makes it impossible for a burglar to penetrate the structure in a few hours. Now let us see what is done to fend off the burglar.

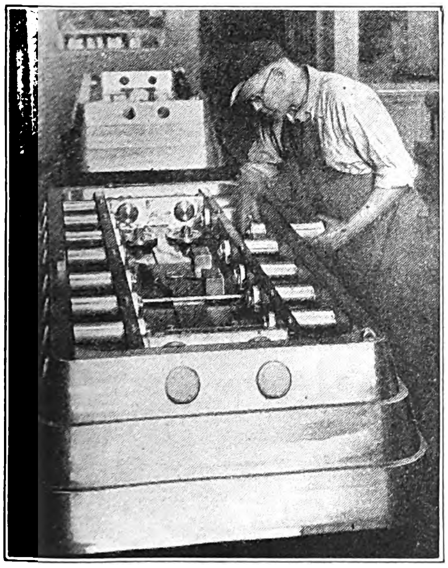
HAND POLISHING
After machining and grinding the plates, the bars and other portions are polished by hand labor with emery and oil to give the beautiful finish we usually associate with vault work

If possible, vaults should be located on or near bed rock. The vault should stand away from the walls so that guards can pass entirely around it. It should be a reinforced room or chamber with walls made as thick, and reinforced as heavily as the building conditions and the available funds will permit. The lining inside should embody three types of resistance in the "layup": resistance to explosive violence, drilling, and burning.

THIS practically fixes a minimum thickness of lining as two and one-half inches made up as follows:

Outer layer,	½″	open hearth steel
Second layer,	1″	torch-resisting metal
Third layer,	½″	five-ply chrome steel
Fourth layer,	½″	open-hearth steel
	2½″	total

The torch-resisting metal could be increased by one inch with advantage and the outer layer might be doubled in thickness; vault engineers and underwriters are not all in agreement on this subject. One burglarious method of entering a vault with reinforced wall and steel lining is to take away a section of the concrete envelope, cut a manhole-size opening through the lining, push the released disk into the vault, and climb in. A buttressing wall is sometimes built inside so that a cut-out disk could not be pushed in or pulled out and would have to be removed in small sections thus taking up much time—and time is the burglar's Nemesis.


FITTING THE BOLTS
Each bolt must be individually adjusted and fitted to take a firm, smooth bearing

The other alternative for the cracksman is to try to enter by one of the doors, of which there are generally two. As explained above, it is necessary to cut a manhole in the lining, but with the door this is different.

THE boltwork which locks a door is operated by a handle or wheel and controlled by combination locks which are checked by time-locks. If the train of mechanism between the boltwork and the locks be broken at any point, it would then be possible to throw the bolts and open the door upon its own hinges, so that a triumphal entry might be made. To break this connection it is only necessary to put a hole through the door approximately one or one and one-quarter inches in diameter. This is sufficient to allow the burning of the connection above mentioned, or the insertion of a bar or cold chisel with which the connection can be broken. For this reason the door is the logical point for burglarious attack and it must be much thicker and stronger than the lining. Doors 36 inches in thickness are not unusual.

The door and the vestibule frame are of cast steel properly annealed. The laminations are placed within this shell, or casting. This is technically known as filling and is illustrated in this article. In addition to the various metals enumerated, a very expensive and very efficient metal, or rather alloy, is sometimes added to render the door practically invulnerable. Doors are either made rectangular or round. A rectangular door properly constructed with heavily rounded corners is just as strong as a circular door and, with modern methods of machining, fits into its joint frame quite as tightly. The real advantage of a circular door today is its advertising value and its appeal to the public. For this reason large banks frequently have two doors leading into the same vault area—a circular door for the safe deposit compartment and a rectangular door for the bank or security compartment. Needless to say, a circular door is much more expensive than a rectangular door.

Every high grade vault should have two doors: a main door and a smaller, emergency door. If for any reason the main door cannot be opened by reason of attack, failure of the mechanism to function (a remote possibility) or for any other reason, the emergency door comes into play. This door must be as strong in every way as the main door and provided with both combination and time-locks. There are, however, thousands of vaults with only one door.

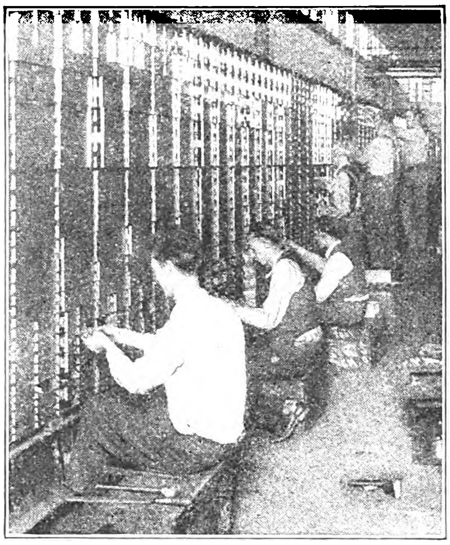
ELECTRICAL protection is an excellent auxiliary but is never a substitute for the main line of defense—the vault. The electrical safeguards, if placed on the outside, will give the burglar less time to operate. Guards or watchmen who ring in regularly to the police station or some protection company are valuable if able-bodied and conscientious, but pensioners are not desirable for this position. Observation space above and below—where the vault does not rest on bed rock—is desirable, and with the use of lights and mirrors, no boring or tunneling can proceed without being detected.

A plant for the manufacture of safes and vaults is very largely a ground floor proposition owing to the great weights involved. At a factory the doors are fabricated and much of the material for the vault walls is prepared, as are also the internal fittings of vaults. The locks themselves are made at a separate factory.

On the vault-fitting floor, the heavy vault doors and vestibules with their component parts are machined and assembled. The open-hearth steel castings pass down the length of the shop from one machine to the other until the doors are set into the vestibules, the hinges and pressure systems applied, and the bolts and boltwork mechanism attached. The work is then arranged so that the doors can be up-ended and taken to the final assembling department where the finishing touches are given. The heavy doors are transported by special cradles suspended from traveling cranes.

ONE of our illustrations shows a door, the inner surface of which is being drilled for the purpose of attaching the mechanism which actuates the bolts. The raw casting has passed through the boring mills where the exterior and interior surfaces are accurately turned and ground; and 24 radial, round locking-bolts will subsequently be applied. The interior of this door or shell is filled with successive layers of open-hearth steel, drill-proof steel, and torch-proof metal so that the three methods of attack known to modern burglars have been thwarted in this type of construction.

Another illustration shows the door being filled. A slab, which is both drill-proof and torch-proof, is lowered into the shell or casting. It is a special non-ferrous alloy that has been developed for this special purpose, and will stop both the drill and the torch.



FITTING SAFE DEPOSIT LOCKS

Safe deposit boxes have locks requiring joint action of customer and custodian

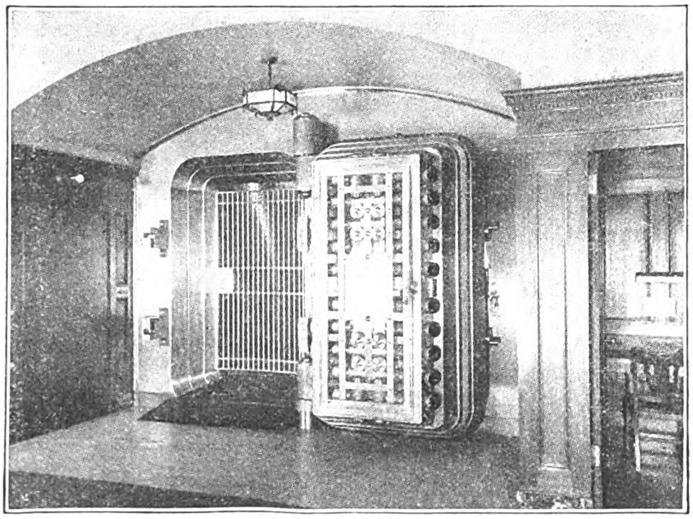
After the various layers are put into the door, the final or boltwork plate is attached. An actuating mechanism and the bolts themselves are set up so that the locking may be accurately performed. The door is then hung on its gigantic hinge, which is attached to the vestibule into which the door swings. The common practice in vault work is to make this hinge twice as strong as is necessary to carry the door's weight without spring or sag, and to facilitate more readily the swinging of this huge weight from the hinge, there are roller and ball bearings used at the necessary points.

Even with the massive type of rectangular door which we illustrate it is necessary for each bolt to be individually adjusted and properly fitted so that all the bolts may take a firm bearing on the jambs when the door is shut, as each one has to do its share in the protection of the valuables within the vault. As might be expected, this requires a high degree of mechanical skill. The plates, bars, and other portions are machined, ground, and then are finally finished with emery and oil, as shown in one of our illustrations. The reason for this is that draw filed steel, carefully polished, presents not only a handsome appearance but shows the least attempt to tamper with the integrity of the vault door or bolts.

The packing and shipping of one of these great doors presents a unique problem since their weight is enormous. The vaults are shipped all over the world—China, Japan, South America, and even sometimes to Europe, where American safes and vaults have always been highly esteemed.

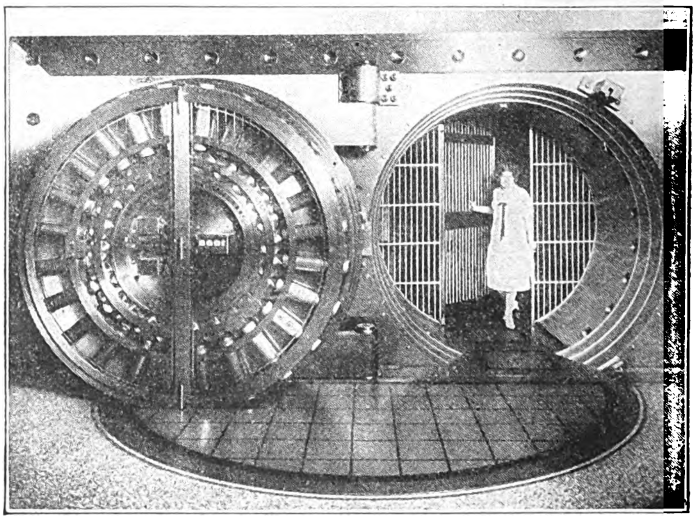
The safe deposit boxes are a part of the work of the vault manufacturers. It is the practice in safe deposit work to use a lock which requires two keys in order that entrance may be gained into the box proper and a tin bond box withdrawn therefrom. Of these two keys, one is called the "guard" or "preparatory" key and is used by the custodian of the vault, being a master key for all the boxes within that vault. The other is known as the "customer's" key and remains at all times in the possession of the customer. Thus it is necessary for both the customer and the custodian to be present with their separate keys every time the box is opened. To be sure that all locks are in perfect working order, they are carefully tested before they leave the vault manufacturer's plant. After testing, the keys are put into a key cabinet for safe keeping.

THE writer is indebted to Mr. Harry H. Lynn, Vice-President of The Mosler Safe Company, Hamilton, Ohio, for assistance in the preparation of the present article, the photographs for which were made under the immediate direction of the writer during a recent visit to the plant. The industry is extremely interesting owing to the masses of metal to be fabricated.



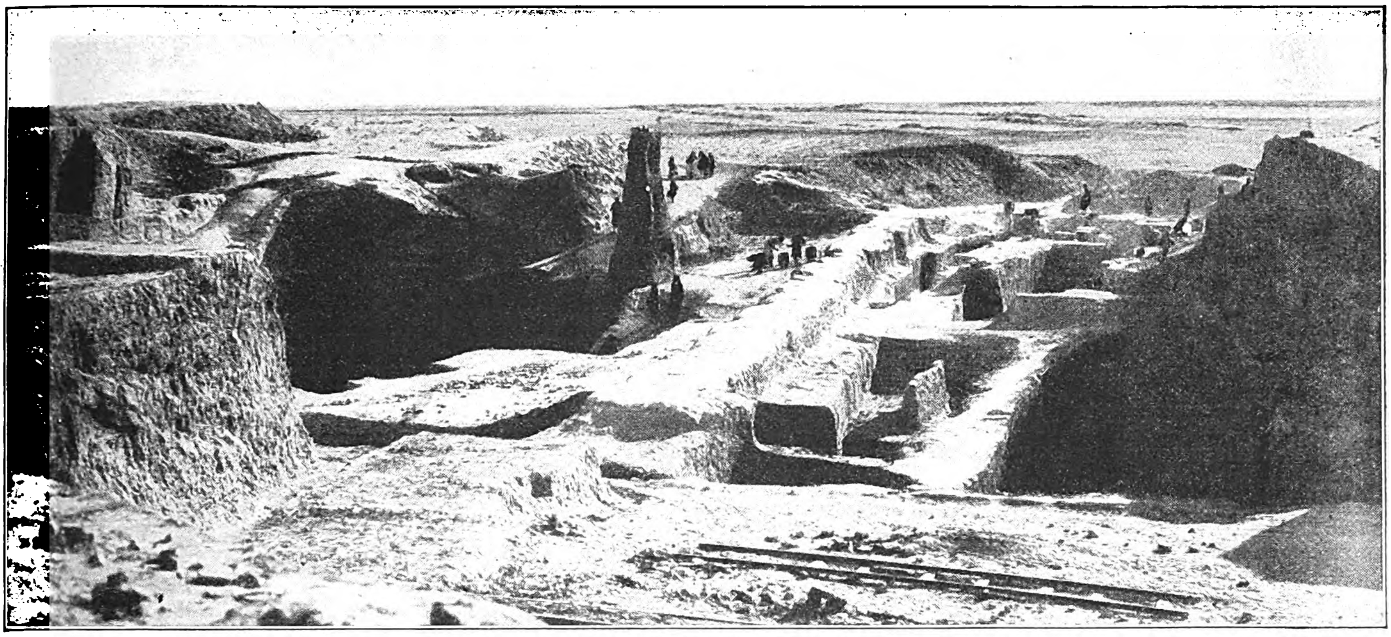
A RECTANGULAR VAULT DOOR

Here we have a vault door of enormous size. The bolts are thrown in one operation. The great hinge supports the door



A CIRCULAR VAULT DOOR

This door weighs thirty tons. Round doors are no stronger than rectangular ones but they have real advertising value

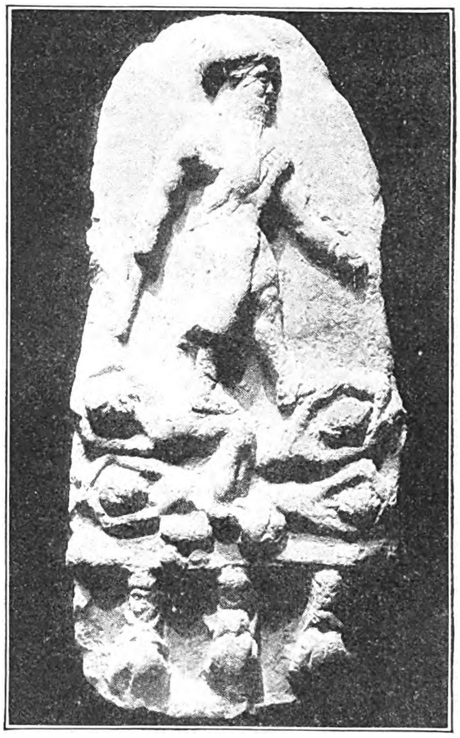


GENERAL VIEW OF THE EXCAVATIONS

The water level was reached at a depth of 50 feet below the original surface of the mound. This was found in the large hole at the left. A few of the basket boys may be seen carrying the earth out of the dump. A section of contractor's light railway is in the foreground

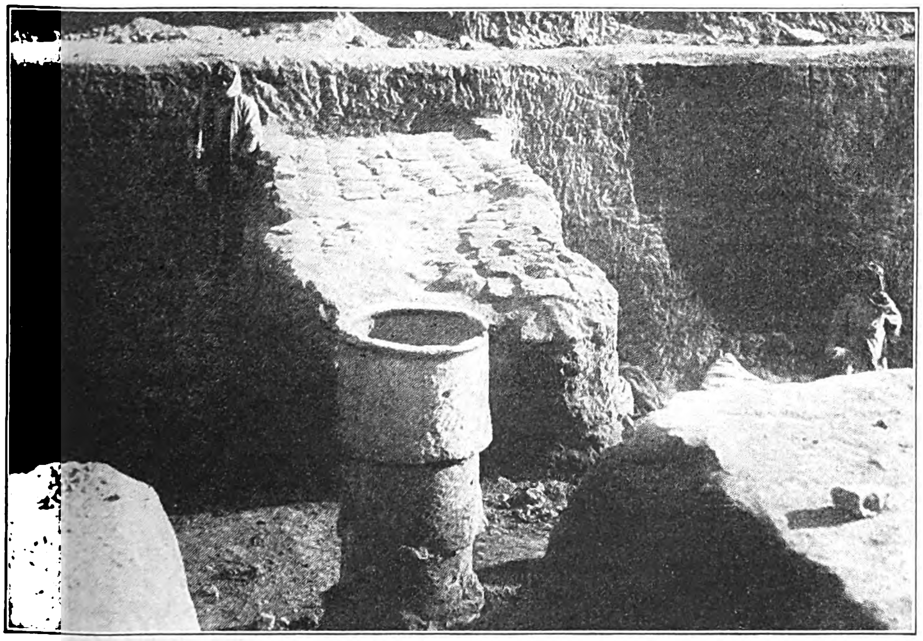
More Light on Sumerian Culture

KISH, in Mesopotamia, was supposed to be the first city built after the great flood of biblical times and therein was established one of the world's very oldest civilizations. See the SCIENTIFIC AMERICAN for March, 1928. Complete evidence of the great flood recorded in Genesis and also evidence of a flood of similar proportions has been recently discovered by excavators. The Babylonian and Hebrew accounts of the deluge are fully confirmed by the findings of the Field Museum-Oxford University Joint Expedition to Mesopotamia, says Professor Langdon. Archeologists of the expedition estimate from the depth of the layer in the excavated site at which the evidence was found, from traces of the damage done by water, and from deciphering inscribed tablets found there, that the flood recorded in the Bible occurred about 3400 B.C. The earlier flood of which the excavators have revealed traces is estimated to have happened some 600 years earlier, at about 4000 B.C. The evidence of the floods is contained in two strata of the ruins of the ancient Sumerian city which now lie at levels about 45 and 55 feet respectively below the surface of the great mound in which Kish was buried. Crushed down through the centuries, the lower stratum now has a thickness of eighteen inches. The expedition workers have bared a length of some 180 feet of this stratum, all of which shows evidence of the earlier flood. These discoveries are regarded as being one of the greatest steps yet made toward reconciling the results of scientific research with Biblical accounts of civilized man's early history.



SUMERIAN ART

The small limestone plaque shows a king trampling on enemies, ranged in two rows



PLUMBING IN KISH

Although these ancients may not have had running water, they at least had good drains and some knowledge of sanitary science. In the background is a pavement with various sized bricks

The Loon Poses For The Camera

Photographs Taken From a Blind at Close Range Reveal the Home Life of this Timid American Water Fowl

By DR. FRANK N. WILSON

Courtesy Bird-Lore

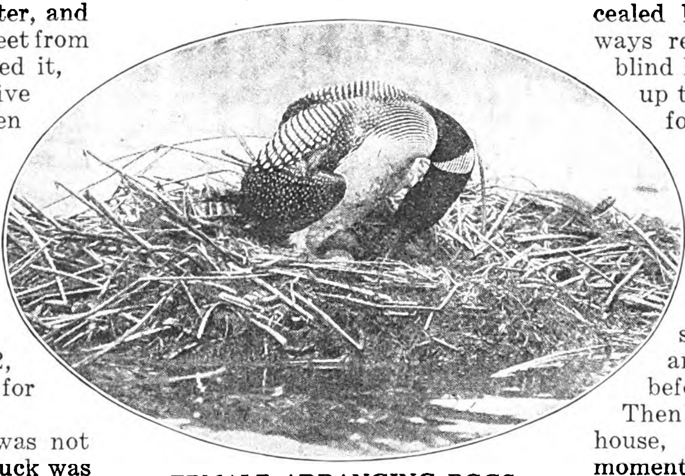
DURING May, 1927, the writer obtained some fairly satisfactory photographs of that interesting bird, the loon, by means of a camera set-up in which the shutter was tripped with a long cord. The results, however, were not wholly satisfactory, and so we determined to make an effort to study this bird at close range the next year.

We made several trips to the shallow lake where our previous studies were made, but we saw nothing of the loons until May 2, when, to our great joy, we saw two birds near a large reed-bed at the east end of the lake. One of the birds soon disclosed the location of the nest and, having secured a boat, we rowed out to examine it.

IN the center of the reed-bed there was a narrow stretch of water, and at the west end of this, 10 to 15 feet from the rim of reeds which screened it, an old muskrat-house, some five feet in diameter, rose six to seven inches above the shallow water. On the east margin of this pile of rubbish, in a slight hollow from which the coarser reeds had been removed, lay the two large, spotted eggs. Incubation had apparently begun some time between April 27 and May 2, and we had ample time ahead for the purpose we had in view.

The water about the nest was not over a foot deep but the soft muck was almost bottomless. It was necessary, if we were to conceal ourselves nearby, to build a blind upon a raft. After considerable computation, involving the specific gravities of lumber, we purchased some pine planks and constructed a platform eight feet square and about five inches thick. In the center of this platform we placed our usual oblong canvas tent and built a strong frame about it. The outside of the frame and the exposed portion of the platform were covered with poultry wire through the meshes of which marsh grass was threaded until the whole looked like a miniature grass house. It was now necessary to proceed with caution; haste in bringing our blind up to the nest might cause the birds to desert and not only waste our labor but injure the nesting prospects of our subjects. Each morning we cautiously advanced it toward our goal until, on May 9, it was only 27 feet from the nest in the shallow water.

We were now ready for photography. The blind lay to the east of the nest so that our work had to be confined to the morning hours. Our usual routine was as follows: We arrived at the lake between 7 and 7:30 A.M., occasionally not until 9 A.M., and after peeping over the ridge to see that all was well Mrs. Wilson rowed me out to the blind. After I had crawled in and set up my camera, she returned to shore and, carefully concealing herself, watched with binoculars. By means of colored handkerchiefs attached to a long stick, which could be thrust out of the back of the blind, I could signal her to come for me or to put the loon off the nest. I was thus able to avoid giving the bird a desperate fright by suddenly appearing nearby.



FEMALE ARRANGING EGGS

The nest affords a convenient island rest for the turtle. The water is a foot deep

Between May 9 and May 28, when the nest was finally deserted, I spent from one to four hours in the blind on 12 different days, and it would be tedious to recount in detail the events which occurred. I shall confine myself, therefore, to a general description of the behavior of my subjects.

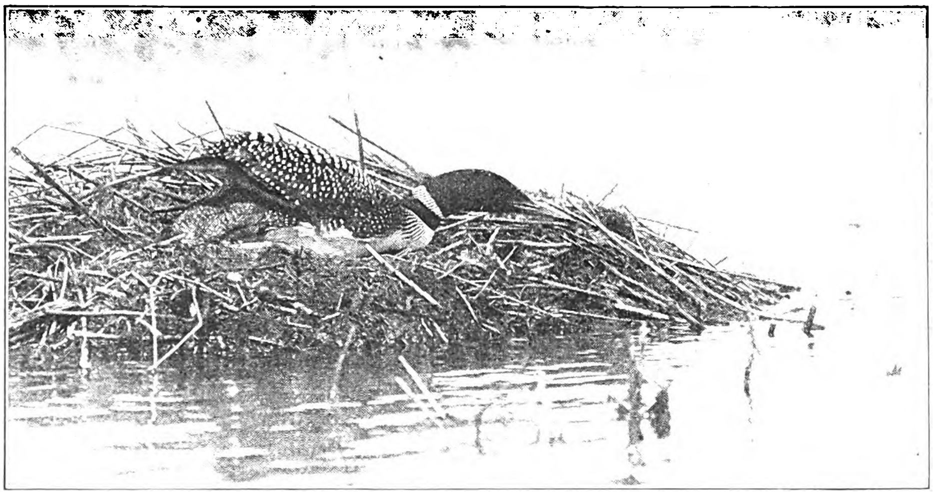
I soon observed that the two loons differed not only in appearance but also in temperament. One of them appeared distinctly larger and more strongly built than the other, and had a more massive head and a stouter beak. From the behavior of this bird I concluded that it was the female and shall so refer to it in the remainder of this article. Both birds shared the duty of incubation, but the male was so much more wary than the female that he occupied the nest for an appreciable period only once while I was in the blind. On several occasions, however, he had approached the nest or actually mounted upon it when the sound of the shutter or some other noise in the blind frightened him away. Similar disturbances were almost completely ignored by the female. I am of the opinion that the female ordinarily occupied the nest and that the male relieved her two or three times during the 24 hours in order that she might secure food. Since the birds were disturbed by my operations, I could not determine their exact routine.

The female was usually on the nest when we arrived. When we rowed out upon the lake she retired and waited patiently some 300 to 400 feet away until I had entered the blind and Mrs. Wilson had returned to shore and concealed herself. The loon almost always returned promptly. From the blind I could see her paddling slowly up to the rushes through which she followed a definite course. Even after I had watched her many times my heart still quickened as she came closer and closer. She seldom hesitated for more than a moment until within three to four feet of the nest. At this point, however, she stopped and swam back and forth for several minutes before deciding to go on the nest. Then she swam up to the muskrat house, and, after hesitating but a moment, with a mighty heave pushed her breast up on the rim of the nest. With considerable difficulty she scrambled up, and, taking one or two quick steps, flopped down on the eggs.

A FEW minutes later she invariably rose and, turning around, stood upright, bracing herself with her wings while she adjusted her eggs. While thus engaged, her bill was always partly open, but only the lower mandible was used in moving the eggs which were shoved far back under the lower abdomen. When they were arranged to her satisfaction, she settled down facing the direction from which she had climbed up on the nest, for it was on this side that the margin of the nest was nearest the water.

After she had made herself comfortable, the loon often sat for from two to four hours without changing her position; her head was, however, in almost constant motion. When

Mrs. Wilson came down to the shore and rowed out upon the lake, the loon dropped her head and held it over the rim of the nest only a few inches from the water. She maintained this position as the boat came nearer and finally, raising her wings slightly, she gave a vigorous push with her feet and slid into the water. The distance of the boat from the nest at the time when she left was very variable; at first she was off almost as soon as it had left the shore and swam out through the rushes without diving. Toward the end of the period of incubation she usually remained on the nest much longer, and once or twice did not leave until the boat was within six to seven rods. When she allowed the boat to come close, she dove as soon as she had struck the water and did not reappear until she was some 200 feet away.



LAUNCHING OF THE LOON

When the young are small the parents abandon their habits of the nesting period and both are seen with the young. During the incubation period, only one parent remains

SOME time during the morning the male usually appeared, and occasionally he was on hand when we arrived. His appearance usually meant that his turn at the nest had come, and I knew that I was in for trouble. I could recognize him a long way off, particularly if both birds were together. In approaching the nest he almost always dove several times, finally appearing close to the rim of rushes some 35 to 40 feet away. He was extremely wary; he would swim toward the nest, suddenly stop, hesitate, and retreat. A few minutes later he would be back again, only to repeat the same performance, and this would go on for possibly an hour. It was most exasperating. On two or three occasions he gave it up and called his mate, who had flown off the lake when he first approached the nest.

After May 20 we began to watch for signs that the eggs were about to hatch. On the 22nd, the female, usually silent, made a great outcry as we approached the nest, otherwise everything went on as usual until the 27th. It was a wonderfully still morning and the lake lay like a mirror in the soft light. The loon complained mildly as we rowed out, and we saw a small, fluffy, black ball in the nest. One of the eggs had hatched. After I had entered the blind the female returned promptly and, after adjusting herself upon the remaining egg, raised her wing and tried to induce the youngster to take shelter under it. The male apparently realized that something important had occurred for he soon came swimming through the rushes and approached the nest. He swam back and forth within a few feet of his mate who cooed to him ever so softly.

During the morning, he made several visits, but finally flew off the lake without disclosing whether he had any special purpose in coming to the nest. When Mrs. Wilson came out with the boat, the female allowed her to approach within a few feet of the blind and then flapped off the nest and, running over the water with wings folded, made a great outcry. The young loon understood and promptly left the nest to join her. They came back to the nest a half hour after we had very carefully concealed ourselves on shore.

In the afternoon we returned to the lake and watched with glasses from the high bank. The two parent birds were out in the middle of the lake with the young one, who sometimes rode on the back of one of them, sometimes swam about near them. Once I thought I saw the male approach the baby and offer it food. After perhaps an hour the female suddenly started for the nest; she swam straight to it, diving a couple of times on the way.

AFTER she had climbed up she spent much time adjusting herself and arranging the reeds about the nest with her beak. The youngster soon climbed on the back of the male and the latter, paddling slowly and carefully, carried him home. When a few feet from the nest he got down and, swimming to the muskrat-house, climbed up to join his mother.

It was a wonderful view of family life in loondom; how I wished that I might have been in the blind to record photographically the return home. I thought that this scene might perhaps be repeated, and the next day I watched from the shore until I saw the female and the young loon leave the nest and join the male. I then cautiously entered the blind. About an hour later the female returned alone as I had expected. Four hours later something frightened her and she left the nest. During all this time, the male and the youngster were having a wonderful time out in the lake. The parent seemed to be giving the young one lessons in diving and in other secrets of loon life.

THE MOTHER LOON

A mother loon with a chick huddling closely under her breast, both being reflected in the water. Loons are the most wary and attractive of our native birds and are hard to study

Pioneering for a Cape to Cairo Highway

A Young Englishman, Driving an American Car, Demonstrates the Feasibility of Establishing a Motor Route Across Africa

By GERRY BOUWER

ABOUT 30 years ago Cecil Rhodes, Britain's greatest imperialist, who was Prime Minister of the Cape Colony at the time, dreamed of one day building a railroad from Cape Town to Cairo. His aim was to build up an African empire for Great Britain, and he visualized the day when Africa would be opened to the world's trade and the world's travelers by a transcontinental railroad.

At that time South Africa was in the early stages of its development. The only existing railroad was from Cape Town to Johannesburg, a thousand miles, and but one eighth of the distance from Table Bay to the Mediterranean. But Rhodes died, and his dream of building up this Cape to Cairo railway has not yet been fulfilled.

TWENTY-SIX years later another British imperialist dreamed of extending British influence in Africa and opening up the "Dark Continent" to civilization. His project was to build a motor highway from one end of Africa to the other. This imperialist is Sir A. Bailey. In a speech which he delivered some time ago, before a distinguished gathering in London, he said that the building of such a road would prove to be the greatest development that could take place within the British Empire.

His declaration aroused worldwide interest. Whole front pages in many African newspapers were devoted to the subject. Soon everyone was talking about the day when the jaded globe trotter would engage a taxi in Cape Town and to the driver give Khartum, Cairo, or Alexandria as his destination.

But in all this welter of excitement no one knew exactly what were the obstacles confronting the building of such a transcontinental highway, and the secrets of Africa's 8000 miles of forests, swamps, and desert were still to be probed by the enthusiastic road builders of modern South Africa. It was to clear up this point that I, accompanied by E. Millin, a journalist on the staff of the Johannesburg Rand *Daily Mail*, set out on the journey from Cape Town to Cairo. In order that our information should be entirely reliable and authentic, we timed our start so that our trip was made in the African wet season and therefore under the worst possible conditions.

We set out from Cape Town on the 8th of February in a Chrysler "72" sedan. Our equipment consisted of a tent, a medicine chest completely equipped with special medicines required in the tropics, mosquito-proof sleeping bags, two rifles, a shot gun, ammunition, and cameras. A month's supply of food was stored away in a box attached to the rear tire carriers. Our food consisted mostly of canned meats and vegetables.

Our route from Cape Town was over the Karoo Plateau to Johannesburg, the center of Africa's gold industry. The road between these two points is fairly good, although of course it is not paved, as are so many of the highways in America. From Johannesburg, which is 1000 miles from Cape Town, the road deteriorated into a mere track which winds through heavily bushed country to the Limpopo River on the borders of Rhodesia. This bush country, which teems with game of all varieties, extends more than 7000 miles to Cairo. On arrival at Bulawayo we had reached our last outpost of civilization. Northward from there was nothing but dense African forests with only native paths for a road. Three hundred miles north of Bulawayo are the Victoria Falls, which are famed throughout the world. Our journey to the falls was made without incident with the exception of a meeting with a very interesting hermit and a herd of elephant that very nearly caused an untimely end to our expedition.

TRAIL-BLAZERS

Gerry Bouwer, with his wife, upon completion of the 8000-mile journey over what may some day be a very busy highway

From the Victoria Falls we journeyed to Broken Hill in northwestern Rhodesia. Before reaching the Victoria Falls we encountered no great difficulty in driving, but once having crossed the Zambesi River, we found ourselves in a quagmire which extends many miles northward to the desert sands of the Sahara. The rainfall in this country averages nearly 100 inches a year, and this terrific downpour is confined to three months of the year. Frequently we did not average more than two miles a day. It was necessary literally to build a road of "corduroy" through the forests.

Fortunately, the natives living in this part of the country were friendly, and in return for a teaspoonful of salt per man we were able to gain the services of gangs of several hundred natives. These gangs were employed in cutting down trees, which were afterwards laid over the ground to form a solid track for the car. The natives were but scantily clad, and when we first met them we were greatly embarrassed to find women and girls in a state of nudity perfectly willing to earn their salt by helping to extricate the car from the morass. After floundering through these flooded forests for several weeks we became quite used to African dress fashions and were not disturbed when whole villages turned out to greet us arrayed in their birthday suits.

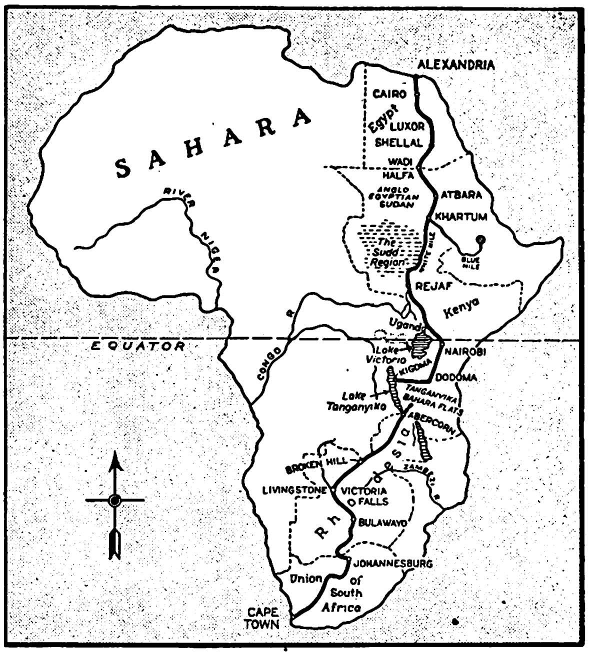
FROM Broken Hill we followed native tracks to the southern end of Lake Tanganyika, passing enroute the spot where Livingston died. Constant heavy rains still made our progress extremely slow and difficult, and we relieved the tedium of digging the car out of one bog after another by hunting the game which abounds in this territory. In the beginning we were thrilled to shoot small game such as antelope, but after a few weeks we became bolder and turned our attention to elephant and buffalo. One day our expedition nearly came to grief, through my folly in hunting elephants in a herd. This narrow escape occurred, curiously enough, on the very spot where Captain Kelsey, who had attempted to drive an automobile from Cape Town to Cairo in 1913, had been killed by a leopard.

From Lake Tanganyika our route was through Tanganyika Territory to Nairobi in Kenya Colony. We had now arrived in Central Africa proper. We set out one night from Dodoma, a railroad station on the Central African Railroad, for Arusha in an attempt to cover 400 miles in 24 hours. It was necessary to make this journey, for we were fearful of running into further rainstorms. All went well until after dark, when we became bogged in a patch of black cotton soil.

FEVERISHLY we set to work to free the car from the clutches of the mud and paid little attention to the cries of African night life which were coming from all directions. But after a while we could not fail to realize that we were more or less encircled by a troop of animals. Brightly shining eyes reflected the light from the car's headlamps, and every now and then these eyes would approach closer and closer to the scene of our operations. After a while I decided to investigate and connected up the spot-light, throwing its beam into the surrounding bush. The moment I pressed the switch I saw that our visitors were lions which were moving stealthily through the bush, gradually creeping closer to the car.

My first thought was to grab my rifle and shoot, but, remembering my experience with the elephants, I decided that discretion was the better part of valor, and turned off the lights. There was nothing for it but to go on with our digging and pretend that we hadn't seen the lions. I do not know if this attitude disturbed them, but the fact remains that after giving vent to a roar of disapproval they disappeared. Had I fired my rifle there is little doubt that they would have charged.

An added danger of travel in this country is the presence of numerous rhinoceros. It is quite generally known in the bush that this clumsy relic of prehistoric times is probably the fastest animal on earth over a hundred yards. Several men have been killed by rhinoceros while driving through the bush. Having been told of these accidents we kept a very wary eye for these animals. On the only occasion on which one showed up, we were able to get away from any possible attack by using all the speed of the car.

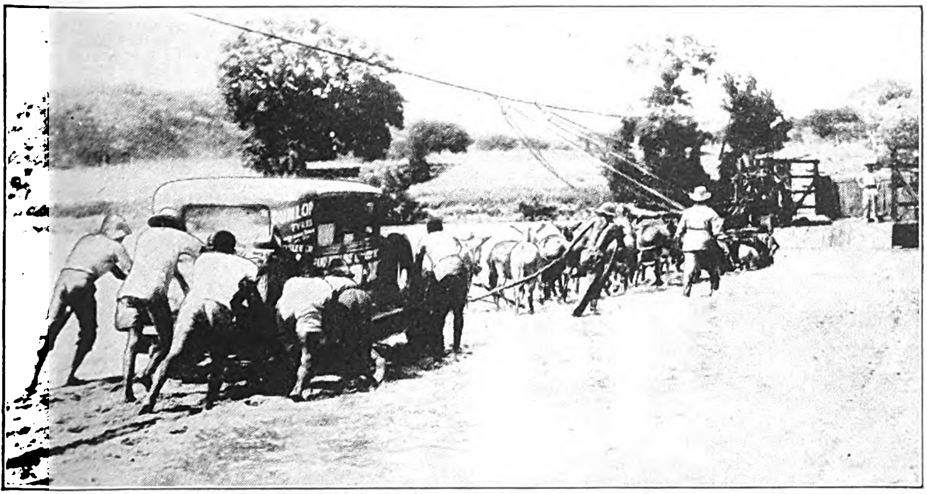


ROUTE OF CAPE TO CAIRO JOURNEY

During the dry season, the journey can be made by the adventurous, as proved by Bouwer's experience

Close to Nairobi we passed the foot of Mount Kilimanjaro, Africa's highest mountain, 20,000 feet above sea level, and we found this section of country to be one of the most interesting in all our journey. At the foot of this mountain range are the Masai Plains, which have been closed to hunters for many years, and are now covered with almost every species of game to be found in Africa.

From Nairobi our route was through Uganda to the lower regions of the River Nile. The roads in this vicinity are good, indeed the best in Africa, and we found no great difficulty in covering the 800 miles. Close to the road are the wonderful Inturi Forests, the home of the gorilla and the African pigmies. We made a special journey to these forests and were greatly disappointed to find that the pigmies are very timid and are seen very infrequently by white men. However, there is no doubt of their presence, and in making one's way from the dense jungles one frequently hears a strange murmuring from the tree-tops. These pigmies are adept at hiding in the jungle, and one can pass within two or three feet of them without being aware of their presence. We saw several gorillas but did not have the opportunity nor time to stop and make a killing.



Courtesy African Films, Ltd.

CROSSING THE LIMPOPO DRIFT IN SOUTHERN AFRICA

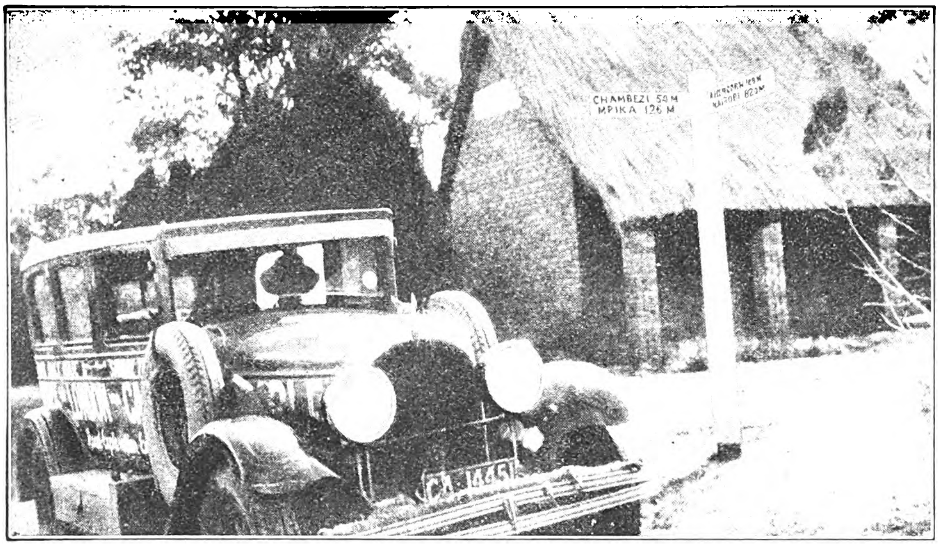
Only by co-ordinating horsepower, mule-power, and man-power, were the adventurers able to cross some of the streams and swamps encountered when traveling in the rainy season

Having arrived on the banks of the Nile we found ourselves confronted with an enormous swamp extending for 1100 miles to the north. This region is known as the "Sudd" and the only means of crossing over these swamps is by the Nile River boat, which we were forced to take. The journey through the swamps to Khartum occupies 16 days and is one of the most monotonous of all African travel routes. For days we saw nothing but miles and miles of papyrus grass floating in the swamps.

NOW and then this tedium was relieved by a stop at an island. These islands are populated by the most primitive native tribe in Africa. Their teeth are filed to sharp points and there is little doubt that they practice cannibalism. No crops are grown and they subsist on milk obtained from huge herds of cattle which they maintain somehow or other on their small islands. Clothing of any sort is nonexistent and they are not amenable to any sort of control by white men. The Sudan Government maintains magisterial outposts in the Sudd, but every now and then a magistrate is murdered by these natives. They have the peculiar and comical practice of standing on one leg, like a stork.

At Khartum we disembarked and prepared ourselves for our journey over the desert to Cairo, 2000 miles away. There is no track whatsoever from Khartum to Cairo, but we had the option of following either the Valley of the Nile or what is possibly the oldest camel route in the world—"The Road of Forty Days."

Unfortunately, however, whereas the camel loves nothing better than deep sand, such a surface is more or less impossible for a motor car, and we were



SYMBOL OF AFRICA'S RAPID COMMERCIAL DEVELOPMENT

In the rainy season, the trip to Cairo took 94 days; the return trip to Cape Town was made in 40 days in the same car, and over practically the same route but during the dry season

forced to follow the Valley of the Nile, making our way as best we could through the ironstone valleys. On one occasion we became lost in the Wadi el Homer and for many blistering hours tramped over great ironstone boulders, seeking a passage for the car. Ultimately, when we were on the verge of despair, we happened upon an Arab caravan which was journeying over the desert to Berber on the Nile. After much gesticulation and the frequent turn-over of our entire Arabic vocabulary we got the leader to understand that we were lost.

Forthwith he led a wild exit straight over the hills to the east, over boulders and along gullys. Time and again in making this journey across the hills we were confronted with what appeared to be unsurmountable obstacles and there was nothing to do but to head the car down an almost sheer drop into a deep gully, depending upon the momentum thus gained to carry the car over the patch of heavy sand in the water course, and then climb the opposite bank. Finally we reached a fairly well defined camel track with a sandy surface, leading to Cairo.

ON my return in the dry season, I planned to do the trip on a schedule of 40 days from Cairo. It was my intention to do this alone, to save space and extra weight. But as my wife—I am newly wedded—had joined me, she insisted on accompanying me on a rather wild drive to establish a speed record for the length of the continent.

Leaving Cairo, we covered Egypt from one end to the other in 24 hours. Then we crossed the Nubian desert, a distance of 600 miles, in three days. We raced the Sudan express from Wadi Halfa to Abu Hamed across the ironstone desert, with the temperature at 120 degrees in the shade. At Khartum, rather than make a detour through wastes of desert, hundreds of square miles in extent, we took portage across 800 miles of the Sudd swamp, consuming 16 precious days. From Mongalla, at the other end of the swamp, another 13 days were used in traversing the 500 miles through the dense African bush.

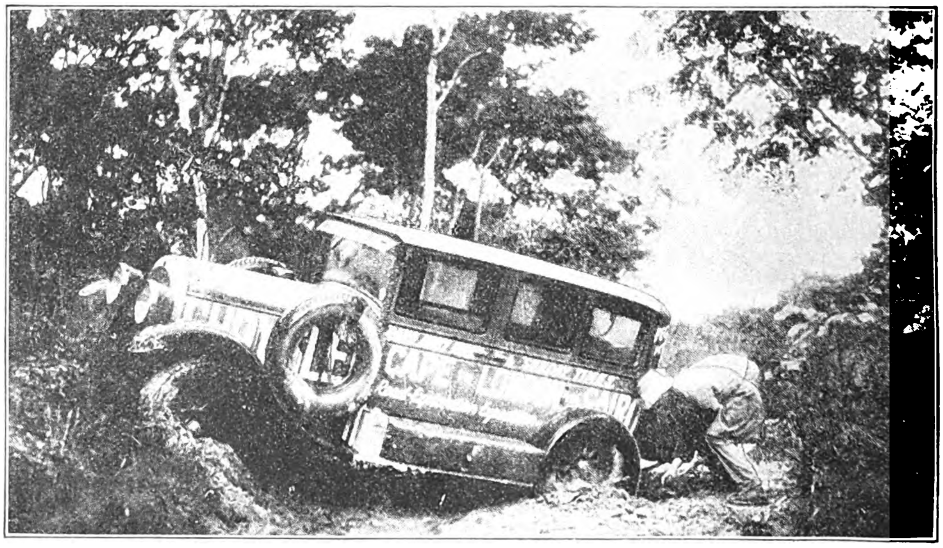
On the final lap from equatorial Africa to Table Bay, we almost encountered disaster going over a bridge rotted by torrential rains. It was collapsing under us, but by using terrific acceleration we got across as the bridge fell. Speeding on south, we reached Uganda, Kenya, and Tanganyika. The fourth day thereafter we were in northern Rhodesia, and found that the whole continent was showing keen interest in our dash.

The next day while fighting through a section of the country that was gripped in a bush fire 50 miles wide, the car caught fire and the trail of dust starting at Cairo all but ended in smoke. I was able to extinguish the flames, but found it necessary to rewire the engine and lamps, causing a loss of 24 hours. During the halt, I learned that the bush fire had been started by a native tribe trapping a herd of elephants for food, making a ring of fire about the herd.

Two days later we reached Victoria Falls, with only five days left to cover the 2500 miles to Capetown. I was breaking under the strain, and once fell asleep at the wheel. The car crashed into a gully, smashing the front spring. This was quickly repaired, and we proceeded on to the Limpopo River, and crossed into the Union of South Africa. At Johannesburg, the whole city turned out to greet us. Normal business was suspended by thousands interested in our journey. We reached Capetown just 27 minutes beyond the 40-day limit, and came to a stop at the statue of Van Riebeek, founder of South Africa.

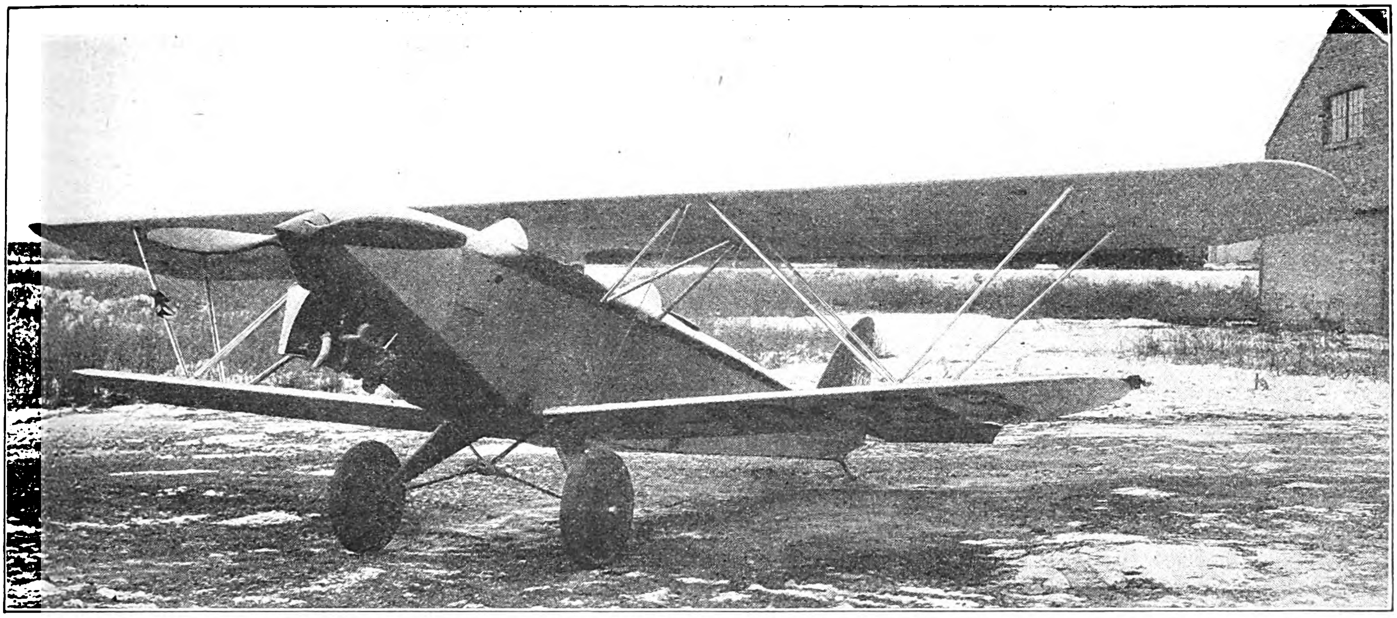
I HAD made the round trip and showed it could be done by any reasonable-minded motorist. The conclusion to be drawn from my experience is that the Cape to Cairo road is practically impassable during the rainy season, and must remain so for many years. But during the dry season, the journey can be made by the adventurous, without necessitating too large expenditures in building the world's longest motor route.

In gathering the stock of information necessary to formulate plans for the proposed highway, the foundation has been laid for a new bond which will link the ancient cities of the Nile Valley with the rapidly developing Union of South Africa. In the last 20 years it has been demonstrated that adequate facilities for motor transportation are superior to railroads in opening up undeveloped regions. The natural development of the continent demands a great trunk highway extending from Alexandria to the Cape of Good Hope. Such a project is feasible.



MUD—A MAJOR PROBLEM IN TRANS-AFRICAN TRAVEL

Digging the car out of the mud became a habit while traversing the native trails in the African bush during the season when almost all travel in equatorial regions is suspended



A NEAT TYPE OF LIGHT PLANE

The Driggs *Skylark* is called by its manufacturers the "personal plane." Powered with a 60 horsepower Rover engine with inverted in-line cylinders, it is said to have a top speed of 110 miles per hour, and it is claimed that it can climb at a rate of 900 feet per minute

Last Call For

Light Airplane Design Contest

THIS is the last notice we can give editorially to those who wish to enter our Light Plane Design Contest as August 15th is the dead line for the submission of designs. All drawings and data eligible for the prize must be in the hands of the Committee on that date.

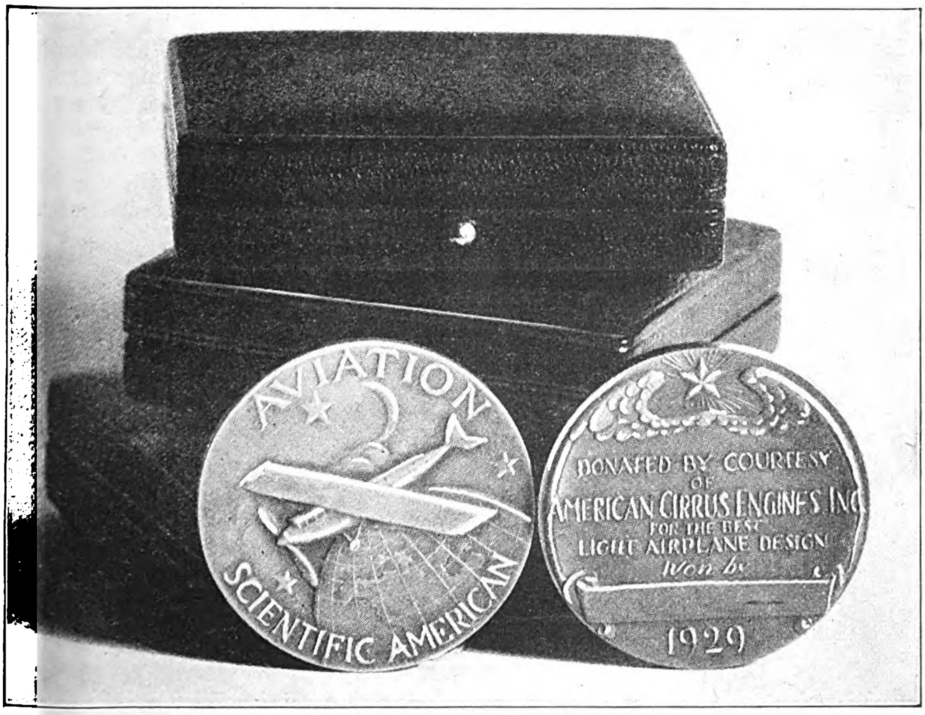
Sixty-eight signed entry blanks have been received at the time of writing. Should any of the remaining seventy-six to whom have been sent the cowling and engine mounting drawings, et cetera, desire to participate, they should take notice that the signed entry blank must be sent at once, so that plans can be made to cope with whatever number of entries there may be.

Among the entrants it is of interest to note that a majority of the large aircraft builders are represented by some member of the organization; most of the prominent aviation schools, both technical and practical, have entrants from men in the junior class up to the Dean of the school. Another significant fact is that an unusual number of entry blanks have name and address printed in lettering which is rather indicative of the fact that the writers have had experience in mechanical drawing.

Supplementing these of course are indicated entrants from all sorts of trades and professions, the total of which makes one ponder upon the wide practical interest of the many outside the realm of aviation business. Surely here must be found the amateur enthusiast who makes up a large part of the ever widening circle for whom the benefits of this contest will have a more particular meaning.

The gold, silver, and bronze medals made by The Gorham Company are especially beautiful examples of the medallic art and with the cash prize of 500 dollars make a reward of sufficient worth to stimulate the interest of professionals as well as amateurs. Then too there is the possibility of the winning designs being acquired for manufacture, which incentive may in the long run be rewarded by an emolument to the designer far beyond the value of the prizes themselves.

It is plainly evident that the success of this contest for light airplane designs is assured.



THREE MEDALS TO BE AWARDED

Besides a cash award of 500 dollars, the first prize winner will be presented with a gold medal such as that shown. Second best design will receive a silver and third a bronze medal

The Home of the Honey Bees

Nature's Nectar Collectors Exhibit Rare Skill in Constructing Their Waxen Combs

By J. H. MERRILL, Ph.D.

"GO to the ant, thou sluggard, consider her ways, and be wise," counseled King Solomon. He was speaking to sluggards. Had he been addressing students in architecture he probably would have said, "Go to the bee, thou student, consider her ways and be wise," for no more marvelous example of architectural skill exists than that product of the bees, the honeycomb.

Yet, how many people enjoy comb honey because they "like the taste of the wax," or ever give a thought as to how this waxen comb is made? Do they believe that it is a product of man's ingenuity?

A beekeeper once submitted the following problem to a prominent mathematician. "What would be the size of the angles of a cell which would give the greatest amount of strength, and, at the same time, require the least amount of wax?" The mathematician's answer called for a six-sided cell with angles which varied but a few seconds from those used by the bees.

AN ordinary bee hive consists of a box, called the brood chamber, in which there are a number of wooden frames filled with honeycomb, where it is intended that the brood, or young bees, shall be reared. On this brood chamber are placed other boxes or supers, containing comb, in which it is hoped that the bees will store honey. While at first glance one is impressed by the seeming exactness of these neatly appearing rows upon rows of cells in these combs, upon closer examination it will be found that their exactness is more apparent than real.

When France was about to adopt the metric system of measurement, it was suggested by Reaumur, one of her most famous scientists, that the cell of the honeycomb be used as a unit of measurement. Had France adopted his suggestion it would surely have resulted in chaos. Each caste of bee requires a cell of particular size, and close measurement will reveal the fact that there is even a slight difference in the size of the cells allotted to members of each caste.

The largest cells in the brood frame, measuring about four to the inch, are the ones in which the queen deposits infertile eggs, which later develop into drones. Her fertile eggs are laid in smaller cells measuring five to the inch, and these become worker bees.

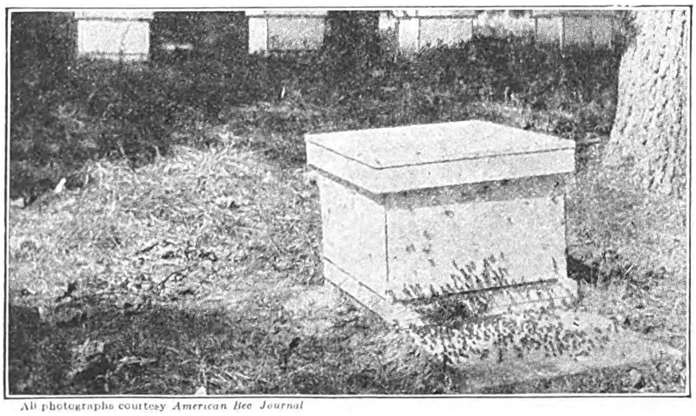
THINGS which yesterday were hidden from the view and knowledge of man are now becoming more and more apparent every day. Some day we may know why a queen bee deposits fertile eggs in worker cells and infertile eggs in drone cells, but with our present limited knowledge, we cannot hazard even a respectable guess.

Drones and workers have their lives directed along different lines from the very start. The workers, Cinderella-like, are reared in modest, flat-roofed cells, while the lazy drones luxuriate in larger and more ornate Gothic-roofed cells. Lying between the worker and the drone cells are irregular-shaped or transitional cells. When the bees desire to raise a new queen they pay deference to royalty by building for her a large, peanut-shaped castle, placed at right angles to the other cells.

In the well ordered routine of the bee hive we find not only conservation of energy but of building material as well. This is typified by the fact that the cells of the honeycomb are used not only as chambers in which the eggs become transformed into adults, but also as storehouses for food. Honey is stored in cells regardless of their size, with a preference, if any, given to the larger size, while the worker cells are used as storehouses for pollen. There is no necessity for keeping pollen airtight; consequently, these cells are left open, but honey and brood require covering. Wax is used to cover the honey cells while a more porous material, which will permit the passage of air, is used over the brood.

Bees gather nectar and pollen from the flowers, but the wax which they use is produced by their own bodies. The body of the bee is divided into three parts, the head, thorax, and abdomen. The abdomen may be distinguished from the other segments of the body by the fact that it is the one which carries the sting. On the under side of the abdomen are eight small plates, which are sometimes called mirrors, or waxplates, and it is through these little plates that all of the wax used in the hive is excreted.

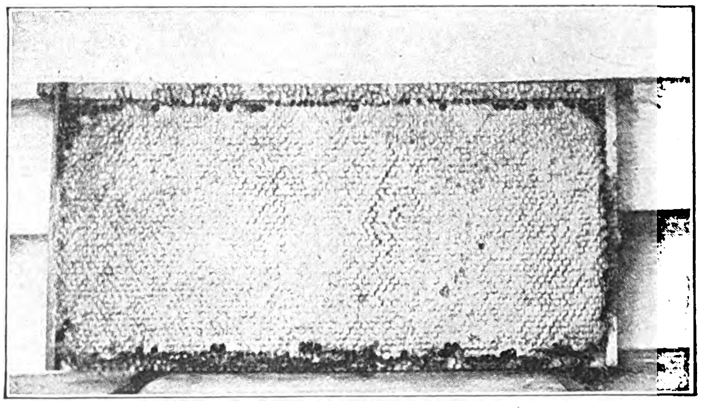
THE making of wax and the building of the comb are two of the most interesting duties which bees perform. Wax makers are like poets, in that they are born, not made, and they resemble them also by following their calling only under favorable conditions. Bees perform different duties at different periods of their existence. As wax producers they are most efficient during the third week of their lives.



All photographs courtesy *American Bee Journal*

HOME OF THE WAX MAKERS

Man provides the habitat for workers, drones, and queen bees; the workers pay the rent by producing both wax and honey

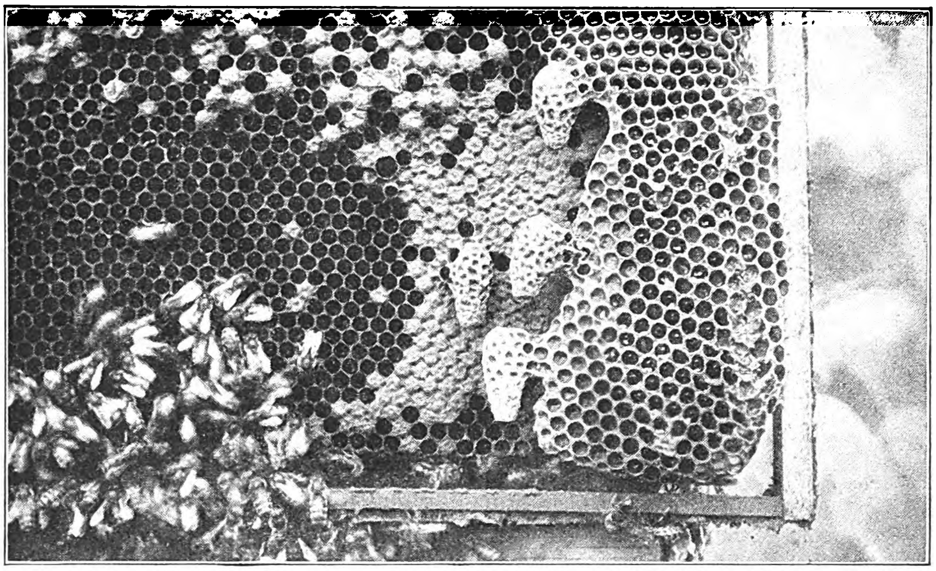


FRAME FROM THE BROOD CHAMBER

For some reason unknown to man, the bees cover the frames with curtains of wax. This wax is then used to construct the honeycomb

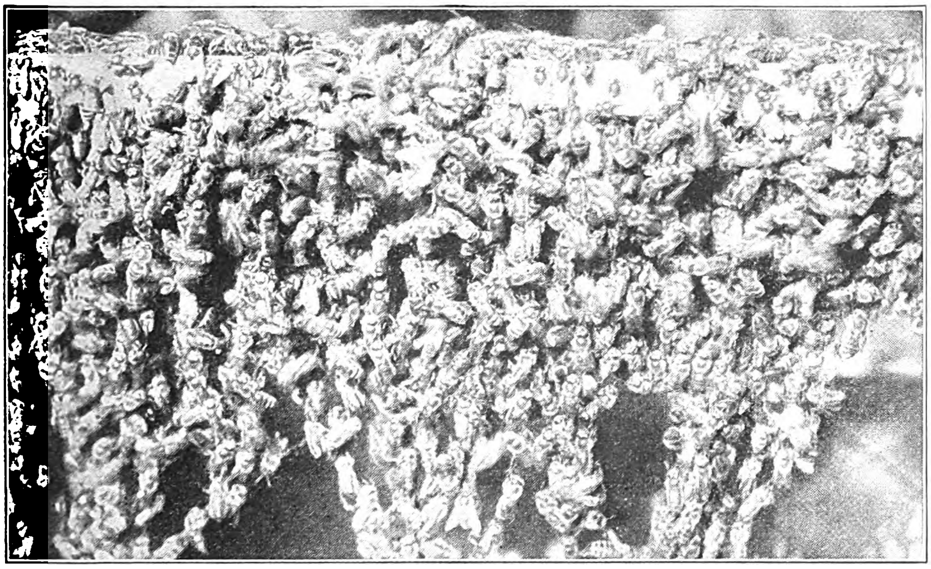
Other conditions necessary for the production of wax are that the hive be warm, and that the wax-producing bees be well filled with honey. When the stage is thus set for wax production, the curtain, instead of going up, goes down. What is still more interesting, this curtain is made up of living bees. Gymnasts, when scaling a wall, mount up on one another's shoulders until the top of the wall is reached, but in forming a wax curtain the bees reverse this process.

First, a row of bees attaches itself to the top of the hive, or frame, then other bees grasp their hind legs, and they in turn are seized by still other bees. This continues, until a series of chains of living bees are festooned across the frame. In about 24 hours the honey within their bodies is transformed into liquid wax, which is excreted through the wax glands, and appears on the wax plates. It then hardens into a thin sheet which the bees loosen with their feet.



PORTION OF BROOD-FRAME

This picture shows cells, capped and uncapped, for queen, workers, drones, and wax



WORKERS BUILDING THE CURTAIN OF WAX

Like an inverted team of tumblers, the bees cling to each other, until bee-chains are festooned over the whole frame. This entire process is described in detail in these columns

It would appeal to the imagination if we could feel that the bees did this in response to a need for wax to be used in comb building. As a matter of fact, however, whenever bees of a wax-producing age, filled with honey, congregate in masses, wax is always produced. Why they form the wax curtain is another of the mysteries of the hive.

After the wax producers have loosened the scales of wax with their feet, the scales fall to the floor, are passed forward to the bees' mouths, or are taken by other bees. These bits of wax are then chewed into a finely granular condition, and carried to the place where the comb-building is going on. They are then laid on the edge of the comb. After depositing the wax the bees scurry away, and other bees bring more wax until finally the comb seems to grow out of nothing.

The only three figures possible for the cells to assume in order to be equal and similar, without any useless spaces between, are the equilateral triangle, the square, and the regular hexagon. It is out of the question for an insect with a round body to build a triangle. A circle would be easier for them, and that is what they really try to build. As each circle touches the other, thick places are formed, and it is in the thinning down of these thick places that the circle becomes transformed into the hexagon.

The bottom of each cell is formed of three lozenges; each lozenge forms one third of the bottom of three opposing cells. Again this is a fortunate arrangement for the bees, but it is not as originally planned. They first try to make each bottom convex, and in so doing they make the bottom of the opposite cell concave. The thinning down of thick places again results in the flat-shaped lozenges.

As the bees continue to draw out the cells they maintain at all times a thick rim on the outer edge of the cell, making it possible for them to work without breaking down its fragile walls. The bees rush here and there, now carrying a piece of wax, now patting it into shape, giving a pinch here and a pinch there with their mandibles. They pause but momentarily, and, apparently, have no regular plan of action. The wonder is that out of all this chaotic confusion is evolved a matchless piece of workmanship.

Major R. W. G. Hingston, in his recently published book, "Instinct and Intelligence," presents many interesting observations regarding insects of various kinds, including bees. In seeking to discover the origin of their remarkable instincts, he points out that deliberate efforts or actions begin by some intelligent process, and such efforts may become so habitual as to seem almost automatic. Major Hingston cites Darwin's observation, "If we suppose any habitual action to become inherited—and I think it can be shown that this does sometimes happen—then the resemblance between what originally was a habit and an instinct becomes so close as not to be distinguished."

It is remembered that any evolutionary process of this kind is subject to the laws of natural selection. If the "instinct" is useful, it will develop; if it is harmful, it will disappear. Instinct, apparently, is an outgrowth of certain deliberate acts of intelligence. In the insect the force of instinct has been developed, as in man the power of reasoning has been developed. Each has brought his own type of development to an amazingly perfect degree, although their evolution has carried them along widely divergent paths.

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

A Bird's Companionate Marriage

AN example of successful companionate marriage among the birds is offered in the life of the rhinoceros hornbill, a large and peculiar bird which has a grotesque sort of beauty, and is native to the Malay Peninsula, Borneo, and Sumatra.

The nesting habits of this bird, which are the subject of an exhibit in the systematic bird series at Field Museum of National History, are extraordinary, according to Dr. Wilfred Osgood, curator of zoology. After pairing, the hornbills select a hollow tree which the female enters. Then, with the assistance of the male, who remains outside, the female walls up the entrance with mud and other materials until only a small slit is left open through which she can throust her long narrow bill. During the entire period of laying and incubating the eggs, and the growth of the young to the flying age, the female remains imprisoned in the trunk. The male, free on the outside to do as he pleases, remains faithful to his mate, returning frequently with food which he deposits in her bill through the slot in the tree, and otherwise assiduously attending to her needs.

This peculiar habit is undoubtedly resorted to as a protection for the eggs and young from the marauding squirrels and monkeys which abound in the tropical forests, says Dr. Osgood.

The male rhinoceros hornbill outside his sealed nest. The female's beak protrudes through the slit

Vast Supply of Anthracite Chokes Rivers

ENOUGH hard coal to supply the demand of the entire United States for anthracite for 10 years—900,000,000 tons of it—lies in banks and bars which choke the valleys of three rivers in Pensylvania, according to a recent report from the Geological Survey of that state.

These figures are not an official estimate, for it is impossible to estimate with any degree of accuracy, but they are a guess which may be accepted, for they are based upon a close observation of the region traversed by these rivers, and upon data compiled showing the amount of coal continually escaping from the mines.

Coal has been accumulating in the creeks and rivers draining the hard coal region since anthracite mining began on a commercial scale a century ago. It is washed from the waste piles of the collieries, which in the old days of mining were the repositories of all the coal that was not of marketable size. These old culm piles, as they are called, contain from 40 to 80 percent pure coal, some of which is chestnut size.

Another and even greater source of coal from the rivers has been the water from the breakers at the collieries. This water carried with it all the coal that passed through the screens at the mine, and for years it was flushed directly into the creeks. There it formed bars and banks that were washed by the force of floods or freshets a little farther down the stream each year.

A flourishing coal salvage business in which nearly 40 companies employing between 400 and 500 men are engaged, has grown up from this coal, and three quarters of a million tons worth nearly a million dollars are recovered from these rivers each year.

The coal, however, is not of the proper size for domestic fuel. It is used by public service companies who have equipped their plants with special grates for burning powdered coal.

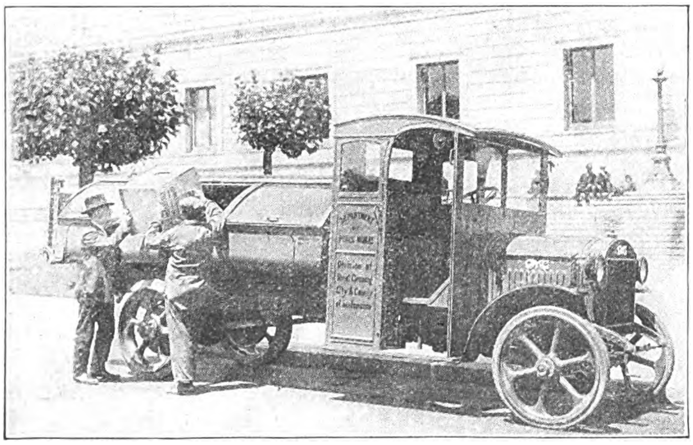
The industry has its center in and around Harrisburg, Pennsylvania, on the Susquehanna River, but coal is also being salvaged from the Schuylkill and Lehigh Rivers. A million and a quarter dollars are invested in dredging equipment for reclaiming coal from these rivers.

The river coal industry is now nearly 40 years old, but the experts who made the survey believe that it will last only 25 or 30 years longer at the present rate of recovery.

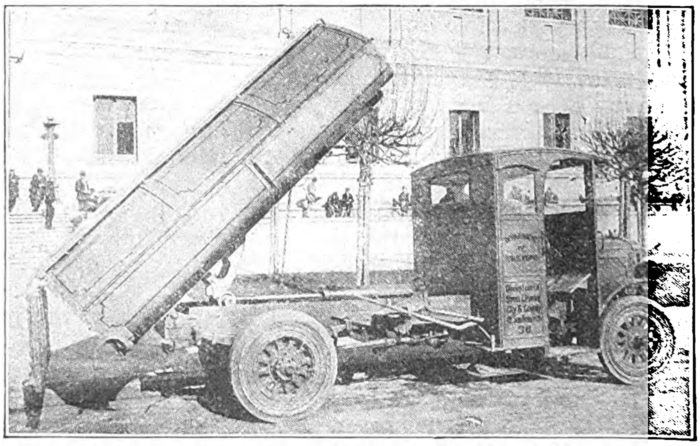
The coal mines no longer waste such tremendous quantities of anthracite as they once did. They have installed expensive machinery that separates practically all of the fine coal from the breaker water, and they are either re-working their old culm piles, or leasing them to reclaiming companies. Briquets and processed coal products are made from the fine coal recovered, or it is sold to public service companies.

But despite the efforts of the coal companies, 1,150,000 tons of coal are still escaping into the rivers each year, the survey men estimate.

The mines are 100 or more miles above Harrisburg, and it is estimated that nearly 30 years are required for the coal from the mines to reach that city. But the long time in the water does not injure it in any way, or destroy its heat value.



Dumping refuse into one of the covered refuse trucks adopted by the city of San Francisco. Only one of the doors is opened, the others serving to retain the dust



With all the cover doors closed, the body of the truck is tilted up when dumping is necessary. Fully loaded the truck does not scatter clouds of dust in city streets

Sanitary Bodies for Street Cleaning Trucks

THE old unsanitary and unsightly method of removing sweepings from city streets has been entirely eliminated in San Francisco by a large fleet of specially designed trucks. These trucks are equipped with covers in three sections on each side of the central rib. One or all of the covers on either side may be pushed backward in a curved frame so that sweepings may be dumped within the body and the cover slid back into place to prevent blowing of the sweepings from the truck to the street.

The cab of these new trucks is built especially low so that the two men who accompany it may rapidly move from each group of refuse cans to the next. In this cab is a special compartment for carrying raincoats and hats so that in case of rain there need be no delay in the collection of refuse.

In certain sections of the city the street sweepers place the refuse in square metal cans while in others the refuse is left in piles in the street so that the street cleaners may shovel it directly into the trucks. Racks on the side of the trucks carry special shovels for this purpose.

By the old open top truck method, only four to six yards of refuse could be handled daily but by use of the new trucks 15 to 20 yards are handled daily by each truck. Each night the truck body and top are thoroughly washed down by hose.

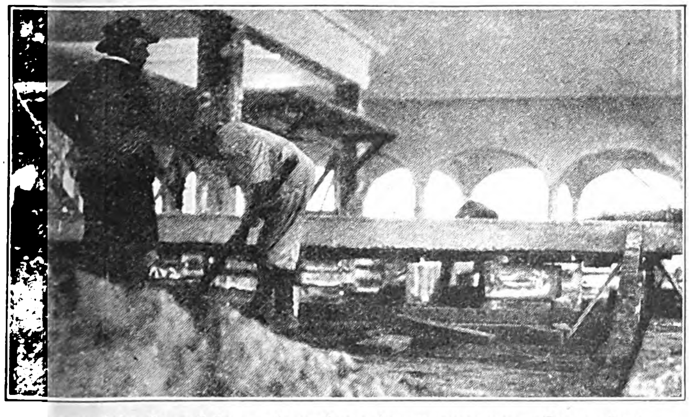
The special bodies were designed by Mr. Peter Owen, Superintendent of the Street Cleaning Department of the Department of Public Works of San Francisco, who is in a position to arrange with other cities for the use of his sanitary truck body.

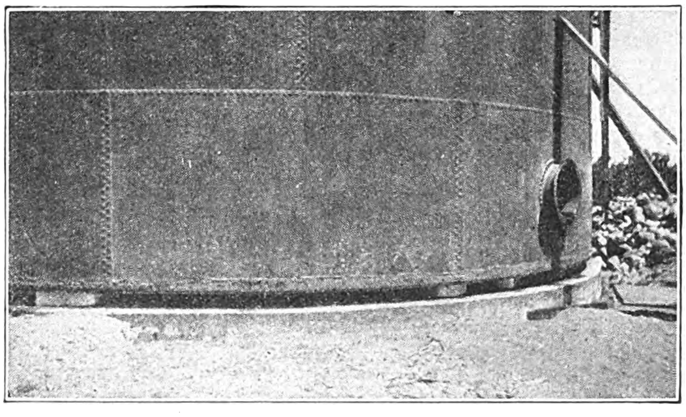
Ice Aids in Engineering Jobs

One would hardly expect to find construction engineers using ice and sunshine to carry on part of their work but in at least two instances these agents have performed valuable services for the engineer. Strange as it may seem, they have been used successfully to do the work of jacks which could not be used due to certain limitations.

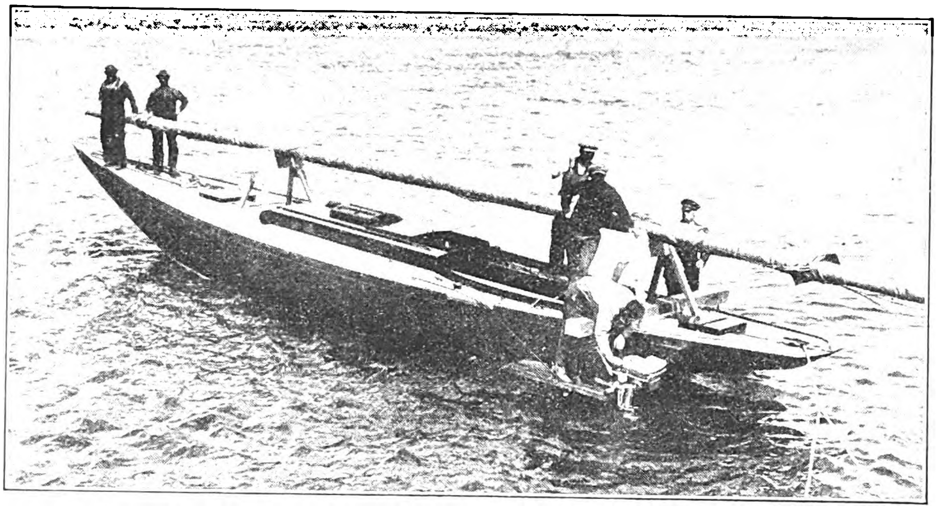
In the first case an orange grower of California wished to lower a large steel tank upon a concrete foundation that had been built for it. Since it was to rest directly on the concrete no jacks could be obtained which would lower it and could then be removed. The orange grower had an inspiration. He drove to the nearest town and surprised his men by returning in a short time with several blocks of ice all cut the same size and shape. These were placed at regular intervals around the foundation and the tank lowered on to them by means of jacks. In a few hours the ice had melted away, leaving the tank firmly and securely upon its foundation.

In the second case engineers of the city of St. Petersburg, Florida, were faced with the problem of lowering a 16-ton concrete slab which formed the floor of a bandstand on the municipal pier. The slab was to be lowered 18 inches and the engineers' problem was to utilize a six-inch space between the floor and the desired level. As in the first case, screw jacks could not be used since they could not be removed after the concrete was in place. The engineers then hit upon the idea of using ice and, as several negroes armed with long-handled mops took care of the water from the melting ice, the slab gradually settled into its new position.


Great blocks of ice, placed under a concrete floor that had already been cast provided the best method of lowering the slab. As the ice melted, the slab settled


Likewise, jacks could not be used to lower this huge tank on to the foundation that had been built for it, because jacks could not be removed. Ice was used

---


It was impracticable to attempt to sail this yacht through inland canals or to ship it by train; therefore two outboard motors were used to propel it

Yacht Transported by Outboard Motor Power

The *Margaret F-IV*, racing yacht owned by Lawrence P. Fisher, well known Detroit automobile body builder, recently demonstrated the latest wrinkle in marine transportation when she left City Island, New York, for Buffalo, via the Erie canal, her sole power coming from two outboard motors lashed to opposite sides of her afterdeck.

When Mr. Fisher decided to remove *Margaret F-IV* from New York to Detroit, he was beset with the problem of transporting the craft between the two ports. The hull was too high to ship by rail, too expensive to tow, and too awkward to attempt to sail, particularly through the locks and canals. So he solved his difficulty by having two big timbers bolted across her after overhang, one across the deck and the other under her counter. Then he had two Seahorse outboard motors hung on each side of this improvised outrigger.

The masts were cradled on the deck, it being Mr. Fisher's intention to rig up the craft at Buffalo and sail her up the lakes to Detroit, her new home port.

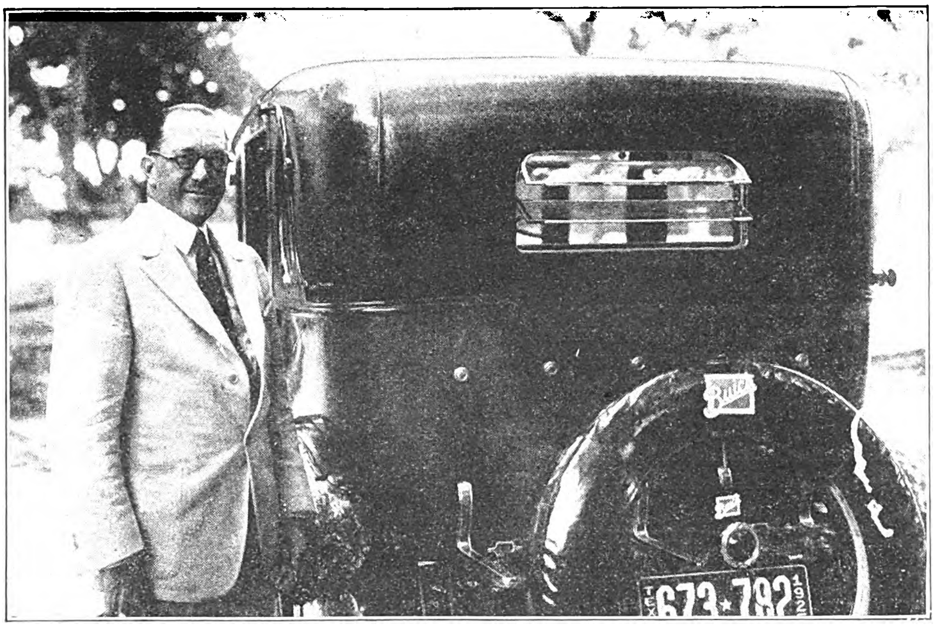
Do Any Scientists Deny Evolution?

Although readers of the Scientific American mainly accept evolution as an established principle, many of them must have had occasion to discuss this argumentative subject with persons who reject it. Many of the latter group delight in repeating the fallacious statement that "the real scientists do not themselves longer believe in evolution."

Of those who repeat this absurd statement the majority are doubtless beyond hope of conviction, and time spent discussing the subject with them is a total loss. Others, however, have sincerely been misled into the belief that there actually is a broad cleavage between the scientists who accept evolution and those who do not. To these our readers may find it advantageous to show the statement quoted below.

This statement is official. It proceeds from the Executive Committee of the Council of the great, all-inclusive American Association for the Advancement of Science. This association takes in all branches of science and includes virtually the entire personnel of the professional scientists of the nation. The statement follows:

"*Inasmuch* as the attempt has been made



Dr. David R. Taylor and his ventilator for the rear windows of automobiles

in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

"*Since* it has been asserted that there is not a fact in the universe in support of this theory, that it is a 'mere guess' which leading scientists are now abandoning, and that even the American Association for the Advancement of Science has approved this revolt against evolution, and

"*Inasmuch* as such statements have been given wide publicity through the press and are misleading public opinion on this subject,

"*Therefore*, the Executive Committee of the Council of the American Association for the Advancement of Science adopts the present resolution, which is a reaffirmation of the resolution adopted by the council of the association at the fourth Boston meeting, December 26, 1922, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 18,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution:

"(1) The Council of the Association has affirmed that so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

"(2) The Council of the Association has affirmed that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

"(3) The Council of the Association has affirmed that the theory of evolution is one of the most potent influences for good that have thus far entered into human experience; it has promoted the progress of knowledge; it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

"(4) The Council of the Association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare, by denying the freedom of teaching and inquiry which is essential to all progress."

Ventilator for Rear Window of Car

THE trend of automobile design of recent years has been toward the closed model, there now being in use far more of this kind than of open models. The problem of ventilating closed cars has been given a great deal of attention by designers due to the fact that cases of death by monoxide gas poisoning have occurred because of lack of proper ventilation. Besides this it is a well-known fact that the air within a closed car during the winter months is usually quite foul and disagreeable.

A dentist of Fort Worth, Texas, Dr. David R. Taylor, has recently patented one of the most practicable rear window ventilators that has come to our attention for some time. It consists of a metal frame which is to be mounted in the rear of automobile bodies to take the place of the fixed window glass which is ordinarily used. In this metal frame there are two plates of glass, the upper one being supported by a metal flange which extends across the top and sides and the lower one being supported by metal flanges on each side. These two are adjustable very much in the same manner as are ordinary windshields. Adjustment is affected by means of a rod which is raised or lowered to tilt the glass plates outward or to close them.

Use of this device allows perfect ventilation of the car during cold weather without creating drafts as would be the case should the front windshield or the side glasses be opened.

An Aid to Irrigation

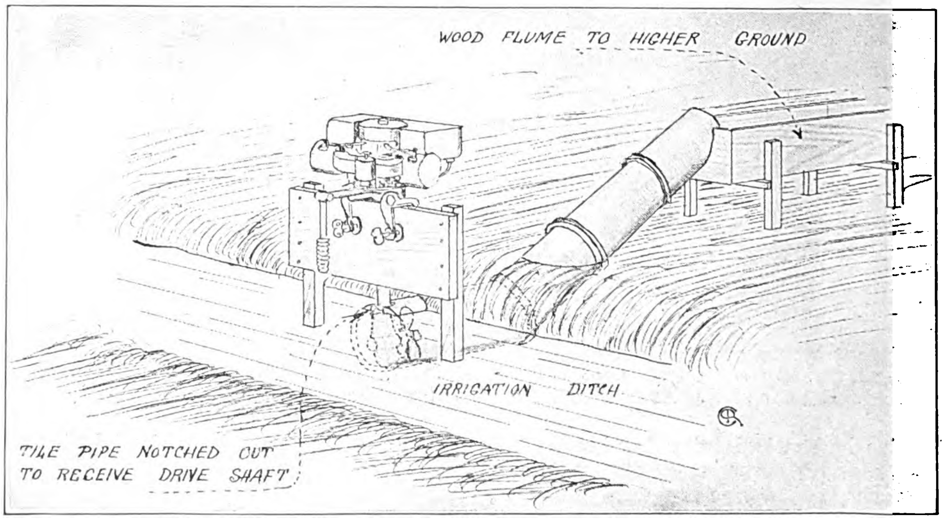
THAT native ingenuity may overcome many obstacles is exemplified in the following letter we received recently from a correspondent together with the accompanying drawing. The letter reads:

"When I visited Uncle Charles last summer he had just acquired some additional land adjoining his own irrigated ranch and found that the general elevation was nearly two feet above his present ditches. To establish a direct gravity flow to the new property would have been a costly job. Since water was available only two days a week he was not anxious to install an expensive pumping plant. In the accompanying sketch I have shown how he used a small motor, outboard type, to accomplish his designs. Running the motor for an hour or so on "water days" was sufficient to fill the ditches on the higher level. Later when the lower part was flooded by spring rains he used the same motor to drain."

Anti-skid Sand Spreader

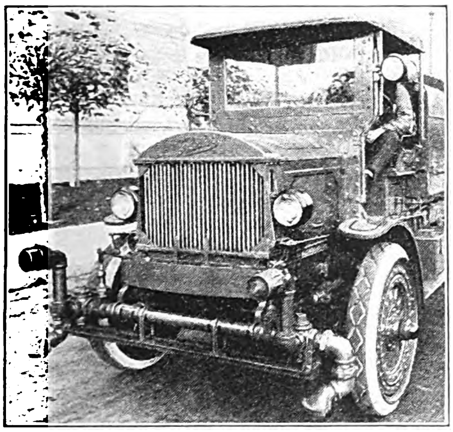
BY means of an ingenious device perfected by Peter J. Owen, Superintindent of the San Francisco Street Cleaning Department, one of the power driven street sweeping machines has been converted into a sand spreading device. It is used for spreading sand over the streets during the rainy season and as an ordinary street sweeper during the remaining months.

When this equipment is used as a sand spreader, the sand is carried in the box or compartment that ordinarily receives the sweepings. A chain operating from the main drive drives a shaft extending across the front of the sand-carrying box. This shaft operates two bevel gears which are


WOOD FLUME TO HIGHER GROUND
IRRIGATION DITCH
TILE PIPE NOTCHED OUT TO RECEIVE DRIVE SHAFT

Uncle Charlie used this motor to lift irrigation water to a higher level connected to a shaft passing down through a section of the sand box. Attached to the lower end of each shaft is a specially designed cone equipped with vanes. These cones have two speeds, spreading sand to a width of 10 feet on the street at the low speed and to a width of 20 feet at high speed, these speeds being controlled by means of a lever at the driver's seat. The sand is fed from the sand box to the centrifugal cone by means of a gate which is under control of the driver. Sand can be fed into the revolving cones in various quantities so that the sand can be spread over the street to a depth of ½-inch if necessary or it can be so adjusted to spread a thin film.

By the use of this sand-spreading machine, the danger of skidding on streets made greasy by oil from motor cars has been reduced approximately 95 percent. A special effort is made during the dry season to remove grease from the various streets. The greasy section of the street is first thoroughly flushed by a flushing machine. Then the sanding machine spreads a heavy coating of sand over the greasy area and the flusher is again sent over the section directing a heavy stream of water against the coating of sand. The sand that is picked up by the water cuts the grease from the pavement somewhat in the manner of sand blasting. If the grease has not been completely removed from the pavement by this treatment, a thin film of sand is then spread over the greasy section and permitted to remain, passing motor cars wearing it off by the action of the tires. During the rainy season, sand is spread over greasy sections by the sand spreader, and then later swept up by the same machine. It is claimed that through the use of this system the streets of San Francisco are freer from oil and grease than the streets of almost any other city in the United States.



The high pressure street flusher which works in conjunction with the anti-skid sand spreader

This sand spreader can sand 52 blocks on Market Street with two yards of sand.

Other cities operating street sweepers could well profit by San Francisco's success in using the sweepers as sand spreaders as the sand-spreading device can be applied to practically any type of sweeper or vehicle able to carry sand.

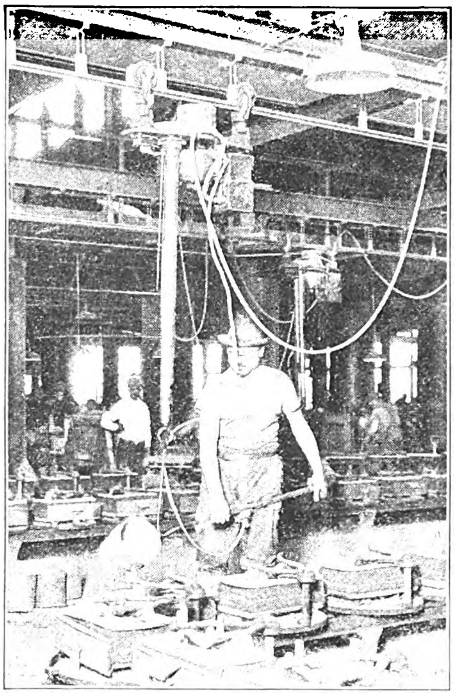
A Mule and a Horse: Twins

THE *News Bulletin* of the Illinois Committee on Public Utility Information states that: "A mare on a Fulton county, Illinois, farm foaled twin colts this spring, one a mule and the other a horse." No details were given.

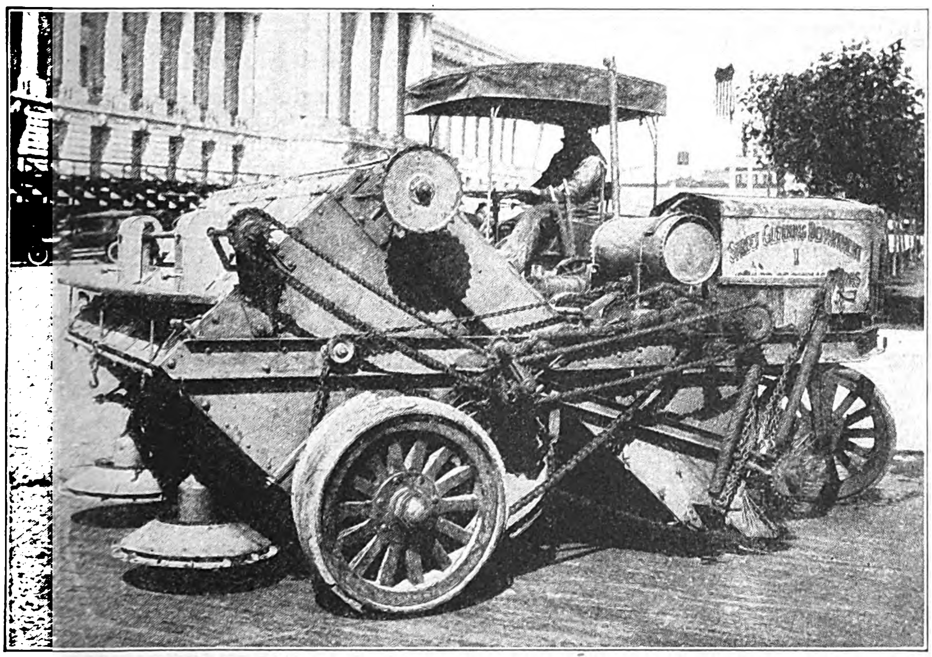
Electrical Metal-Pouring Service

THE LOUDEN MACHINERY COMPANY, of Fairfield, Iowa, recently announced an electric pouring device for handling the pouring ladles in foundries. This unit consists of an electrically operated carrier which may be suspended from a standard monorail or used with a special pouring crane.

As shown in the accompanying photograph, the electrical equipment of this device is overhead just beneath the monorail track. A telescoping arm hangs downward to hold the ladle while a workman guides it from mold to mold. The rigidity of this lifting arm permits accurate spotting of the ladle over the mold. The motor which lifts or lowers it is controlled by a switch at the workman's finger tips. It is said to be quite quick to respond, and smooth in operation; and will allow the operator to raise the ladle while pouring without interrupting the flow of metal. The device is furnished for either alternating current or direct current operation.



While molders are molding, common labor can pour metal with the aid of this new electrical device



The anti-skid sand spreader. On rainy days when the streets are slippery with oil and water, sand makes the surface skid-proof. Note cone spreaders

10,000 Miles of Locomotives

JUST 100 years ago—in 1829—the locomotive, *Stourbridge Lion*, underwent a test that was so successful that the question of whether horse traction or steam traction was to be used on railways was settled once and for all. According to *Railroad Data*, American railroads have grown twice as fast in the last 25 years as they did in the preceding 75 years. This statement is attributed to R. H. Aishton, President of the American Railway Association, in an address before the tenth annual convention of the Transportation Division of that organization.

He said further: "And even though rail transportation has existed for 100 years, it is in only the last 25 years that a real science has been made out of it. It took 75 years, or until 1902, to build a total of 258,784 miles of track. In the 25 years following there was built 163,516 miles. In other words, in the last quarter of a century the railroads grew twice as fast as they did in the first 75 years. This is significant, for it shows how you [railroad men] have adjusted yourselves to the change in tempo. This adjustment has been all along the line, in plant facilities, more mechanical improvements, improved methods, but most essential of all in changed mental attitude. All of these changes have contributed in the last six years to the splendid performance in rendering a transportation service that, in so far as its relationship to demands is concerned, might be regarded as nearly 100 percent perfect. There were loaded last year on the American railways 51,576,731 cars of revenue freight, and this stupendous traffic was handled with a minimum of delay and with great efficiency.

"If you took this total of cars that were loaded and put them into a solid train and

(*Please turn to page* 180)

Learning to Use Our Wings

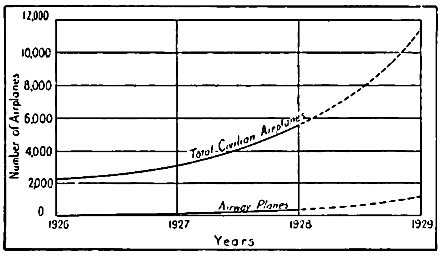
Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

How Many Airplanes In 1936?

IT is always dangerous to prophesy in matters of technical progress. Captain L. M. Woolson, one of the Packard engineers associated with the development of the aircraft Diesels predicts, however, that there will be 1,500,000 airplanes in service by 1936. This prediction is based on the appended chart of airplanes in service between 1926 and 1929. This indicates a doubling of the number of airplanes in service every year, and the figure of 1,500,000 is arrived at by postulating the same rate of growth.



Based on this chart, made from figures supplied by the Aeronautics Branch of the Department of Commerce, it is estimated that there will be 1,500,000 planes in use by 1936

Cowling to Reduce Drag

THE radial air-cooled engine possesses many advantages over the water-cooled aircraft engine in that it is lighter, and avoids the complication of radiator and piping. It is not so advantageous from the point of view of vision, and it introduces quite a large amount of air resistance or drag.

Aircraft engineers have long sought methods of decreasing the drag of the exposed cylinders by using various forms of cowling. It is impossible to cowl the engine in entirely because it will overheat; cylinders and valve gear must always remain exposed. The N.A.C.A. has recently conducted an exhaustive research into the problem, mounting engines in the front part of the fuselage and measuring the drag in the wind tunnel with various forms of cowling. Some most interesting conclusions have been reached:

1. The drag of an averaged sized cabin fuselage with the nose rounded is tripled by placing an uncowled Wright J-5 engine on the nose (this is the famous Whirlwind which Lindbergh used in his transatlantic flight, and which develops 200 horsepower).
2. The conventional form of cowling in which part of the engine is covered over and the cylinders and valve gear are left exposed reduces the drag by only a negligible amount.
3. But if a cowling such as that shown in our diagram is used, then 60 percent of the drag due to the engine disappears.

The great advantage of this type of cowling which covers the entire engine is that it separates the cooling air from the general flow about the body. The reduction in drag is thus easily explained. At the same time the central opening admits sufficient air to insure proper cooling as both the tunnel and the flight tests have shown.

With this cowling the gain in performance is quite surprising. For example, a cabin airplane, equipped with a 200 horsepower engine, will have its speed increased from 125 miles per hour to about 133 miles an hour. Since the airplane is already a fairly well-streamlined body such a gain is well worth having.

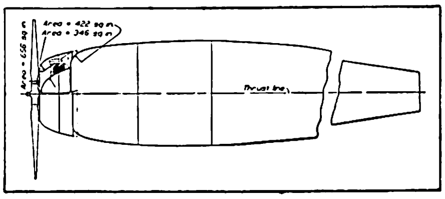


Diagram of N. A. C. A. cowling, showing that it separates the cooling air from the general body flow

Airports and Airways

AERONAUTICAL books now appear with such frequency that we could fill the whole of this department with reviews. Still, our readers no doubt like to keep posted on the ever-increasing literature of aviation.

"Civil Airports and Airways" by Archibald Black, (Simmons-Boardman, New York) is an excellent treatise on the subject, compiled with the collaboration of 19 specialists. It is extraordinary how complex the subject is apparently becoming. The clearing of the flying field, grass seeding, oil treatment of soil where no grass is growing, the various materials which may go into the runways, the buildings required, fire protection, lighting—there are innumerable things to be considered. There is no doubt that the text is excellent and as up-to-date as a book can be in this rapidly developing branch of engineering.

We believe that just as much attention should be given to the construction of seaplane bases as to the development of land terminals and are glad to see a chapter devoted to this special subject.

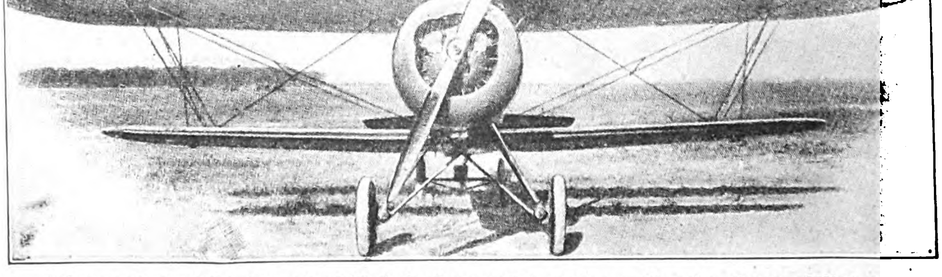
Seaplane base locations should be on some river, small lake, or other body of water which is free from heavy swells. If located on the shore of a sea or a large lake, a small bay or other partly protected body of water is needed.

Seaplanes, even of the best modern design, require greater lengths for take-off than land planes. Hinton, who has written this section of the volume under consideration, recommends an area 3000 to 4000 feet long by 1000 to 2000 feet wide, provided the greater length is so orientated that it lies in the direction of the most frequent take-off. The operating area must be free of high surrounding obstructions. A depth of six feet is considered sufficient to provide draft for any present day seaplane.

To facilitate handling of seaplanes between hangars, shops, and the water an arrangement of aprons, inclined ways, or a marine railway is necessary. The launching ways should not be inclined more than 15 degrees. The seaplane ways may be constructed of wood, with two or more rows of piles driven into the sand, beams set on edge on these and securely spiked to them. Where the largest types of seaplanes are to be handled, it is necessary to install a regular marine railway, using steel rails in place of the single wood track or the launching ways. There is evidently a good deal to the design of a seaplane base, and those seeking further information will certainly read Black's book with profit.

The Fifth National Air Tour

THE National Air Tour has been entirely reorganized, with new management and a new route. The flight this year will start from the Ford Airport, Detroit, on October 5, with the return to Detroit scheduled for 16 days after. The route will be approximately 4400 miles long, and will run from Detroit to Toronto, Ottawa and Montreal,



A front view of the Curtiss AT-5 airplane with new cowling in place. With it, **60 percent of the drag due to the engine disappears, and efficiency increases** in Canada; then to Portland, Maine; Boston, Massachusetts; New York, New York; Philadelphia, Pennsylvania; Baltimore, Maryland; Richmond, Virginia; Charlotte, North Carolina; Greenville, South Carolina; Savannah, Georgia; Jacksonville, Florida; Macon and Atlanta, Georgia; Nashville, Tennessee; Louisville, Kentucky; St. Louis and Kansas City, Missouri; Des Moines, Iowa; St. Paul, Minnesota; Milwaukee, Wisconsin; Moline and Chicago, Illinois; and Kalamazoo, Michigan. Cities where overnight stops are to be made are asked to provide 1000 dollars for gas and oil and hotel accommodations for one pilot and one mechanic from each entry. All competing planes must have the approved type certificate issued by the Department of Commerce.

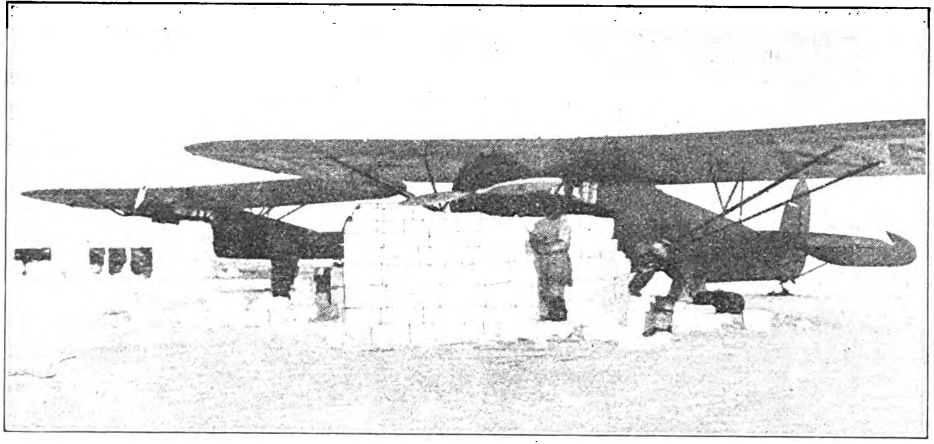
An extremely important addition to the rules is that no work will be permitted on competing planes during the night stops. All planes will be placed under guard at night to prevent any surreptitious work. The Air Tour thus promises to be a real reliability test.

For marking of the competitors there is a mathematical formula which at first sight appears very mysterious. This is:

$$\frac{\text{Max. D. of C. Useful Load} \times \text{Max. Speed}}{\text{One-half Stick plus Unstick}} \times \frac{50}{\text{Disp.}} = \text{Merit}$$

What this means in English is that the Merit of the competing plane will be obtained by multiplying the maximum useful load permitted by the Department of Commerce certificate by the maximum speed developed in any leg of the route, multiplied by 50, and then divided by the time in seconds required to come to rest after landing, plus half the time required to make a take-off, multiplied by the displacement of the engine in cubic inches.

This rule is logical since that plane will be the best which will have the greatest useful load, the greatest speed, the shortest time to take-off, the shortest time to come to rest, and the smallest engine. Of course all such formulae are arbitrary, but the above formula undoubtedly offers a fair basis of comparison.



In cold weather it is necessary that airplane motors be treated with utmost care, to avoid trouble. In Canada, snow huts are erected to protect them

A Convertible Craft

OUR photographs show an interesting type of convertible airplane to be manufactured in this country under Belgian license by the Gates Aircraft Corporation.

The conversion from monoplane to biplane or from biplane to monoplane takes only two hours. It is apparently quite simple to remove or add the lower wing and to substitute the appropriate wing trussing.

The two-seater is equipped with a 110 horsepower Renard engine. As a monoplane it has a gross weight of only 1600 pounds, a cruising speed of 112 miles per hour, and a landing speed which is not unreasonable for a skilled pilot.

For primary training, or for use in urban areas where the airport is restricted in size, the addition of the lower wing gives so low a wing loading that a landing speed of 27 miles per hour is claimed, with a high speed of well over 100 miles per hour.

Just as the convertible automobile serves a very useful purpose, it is not impossible that the private or even the commercial operator may find such a convertible airplane of real practical service.

Eskimo Motor-Warming Sheds

IN starting an engine in cold weather, quite a number of precautions have to be observed. It may be necessary to adopt some method of heating the air entering the carburetor to prevent the formation of ice at the chokes. The Wright company provides special air-heaters for this purpose. In very cold weather it is sometimes necessary to preheat the oil before starting and it is good practice to drain the oil from the tanks as soon as the day's operations are concluded and before the oil has had time to cool off. If left over night, the oil may become so viscous that it will take a long time to drain off. Some authorities recommend lagging on the external oil pipe lines, the lagging consisting of a layer of asbestos cord, shellacked and wrapped with friction tape to hold it in place.

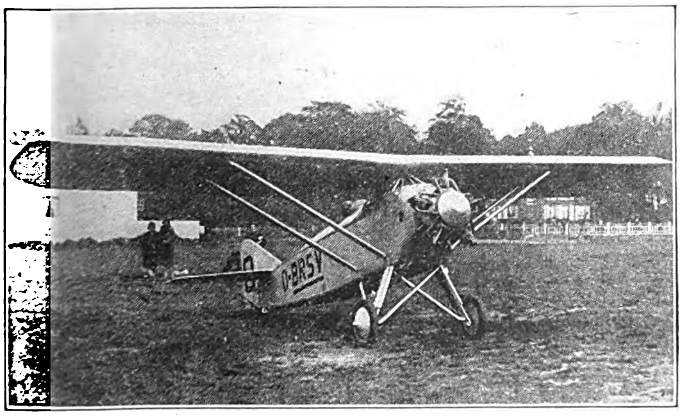
Priming the engine has to be more energetic in cold weather than under normal temperature. If all these precautions are necessary in our climate, we can imagine what the difficulties are in the bleak Canadian northwest. Canada's flying gold-hunters have had to resort to special shelters of snow around their engines. The accompanying photograph shows native ice masons building a shelter around two Fairchild cabin monoplanes used by these hardy explorers.

Organization of Private Flying Clubs

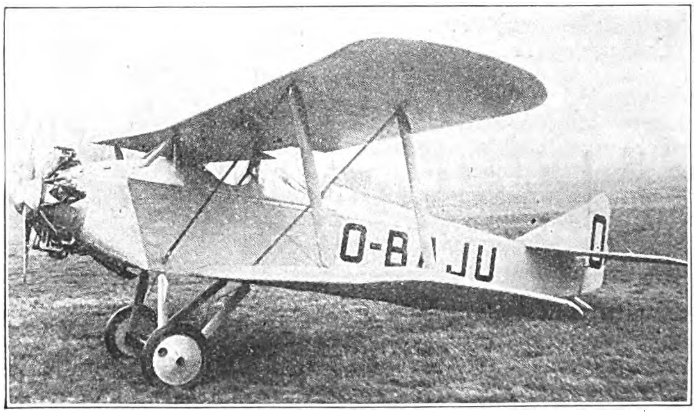
THE *Aeronautic Review* announces that after a year's study by a special committee, the N. A. A. has developed a private flying club plan. A grant of 12,000 dollars by the Daniel Guggenheim Fund for the Promotion of Aeronautics will make this plan immediately effective as it will permit the employment of a secretary giving all his time to the project.

Here is the procedure recommended by E. P. Warner, chairman of the Private Flying Club Committee:

1. Get together a congenial group of pilots and would-be pilots, not less than 10 and preferably not more than 30 in number, who can afford among themselves the price of a suitable airplane, with a small reserve for contingencies.
2. Decide what type of plane you prefer to buy. It must be a type having an approved certificate from the Department of Commerce, and will have to have the approval also of the insurance underwriters.



The Gates airplane as a monoplane



A Gates plane fitted as a biplane

3. Decide on the field from which to carry on operations. It is recommended that the operations of private flying clubs should not be based on large metropolitan airports where transport and commercial flying are actively carried on, but on more secluded fields used primarily for instruction and private flying.

4. Make tentative arrangements for hangar accommodations.

5. Decide whether there is to be a professional operation manager or whether the officers of the club will direct operations themselves. If it is expected that a large amount of instruction to student members will be given, there should, in general, be a professional instructor. This has been the practice of the British and Canadian clubs.

6. Write to the Private Flying Club Committee, N. A. A., and apply for a charter. A charter will be granted upon approval of the plans and will be issued together with an insurance policy on the club's operations.

From the financial angle, insurance is an important feature. Apparently if there are 10 members, and a plane worth 5000 dollars is bought, each member will have to pay 125 dollars for insurance, to cover fire, lightning, crash damage, public liability up to 20,000 dollars for one person, et cetera. This item of insurance looks rather large. No doubt it will be reduced as time goes on.

The following are the recommendations for the financial organization of the club:

The total sum to be collected from the charter members of the chapter for the purchase of planes should be equal to the cost of equipment to be bought, plus a 25 percent reserve, plus 200 dollars for general operating expenses. A typical sport plane costing 4000 dollars would thus require an initial fund of 6000 dollars. The membership dues should be 15 dollars for flying members and 25 dollars for non-flying members.

The committee further recommends that there should be a basic charge of 10 dollars per hour for the use of the club's airplanes by flying members on local flights. The rate of 10 dollars per hour is based roughly on the following distribution:

Gas and oil	$ 2.25
Hangar accommodations (based on 300 flying hours per year)	1.35
Mechanical service (inspections and handling machine)	1.00
Engine overhauls and minor repairs	1.00
Minor repairs to airplane not covered by insurance	1.50
Depreciation reserve (to allow for purchase of new plane after 1500 hours)	2.70
Miscellaneous	.20
Total	$10.00

There is no doubt that the plan is the result of exceedingly careful study and that the recommendations are very reliable. Flying clubs have been entirely successful in England; with such wise guidance, they should be equally successful in the United States.

The Ideal Streamline

PROFESSOR B. MELVILL JONES has recently read a paper before the Royal Aeronautical Society on the "Streamline Airplane" which has attracted much attention. He begins his paper with the following striking remarks: "Ever since I first began to study aeronautics I have been annoyed by the vast gap which has existed between the power actually expended on mechanical flight and the power ultimately necessary for flight in a correctly shaped airplane. Every year, during my summer holiday, this annoyance is aggravated by contemplating the effortless flight of the sea birds and the correlated phenomenon of the beauty and grace of their forms."

Roughly speaking there cannot be lift on a wing without drag, because at the ends of the wing the pressure difference between the upper and lower surface of the wing causes an end flow and loss of energy in the form of tip vortices. The lecturer assumes that these tip vortices cannot be eliminated. Neither can the skin friction of the wings be eliminated. No matter how smooth a surface may be there is always bound to be skin friction.

Wind tunnel experiments, however, show that a perfectly streamline body has little more drag than would be accounted for by the skin friction on the surface. Suppose, then, that we can build an airplane which is perfectly streamline. The only resistances to be overcome would be the tip vortex drag and the skin friction.

With such ideally streamlined airplanes, large machines could fly at their present speeds for one third the power, or alternatively travel some 60 miles an hour faster for the same power. Certainly these are results worth attaining.

As design progresses, all external obstructions will disappear. The airplane will be as well streamlined as the bottom of a racing yacht, or the externals of an albatross.

An Unusual Photograph

OUR photograph of the De Haviland 66, is, we believe, a most unusual one. It shows the craft aloft and flying apparently level, with only two of three engines functioning. The right-hand propeller is quite evidently out of commission. There is no doubt that the multi-engined power plant offers a real increase in safety.

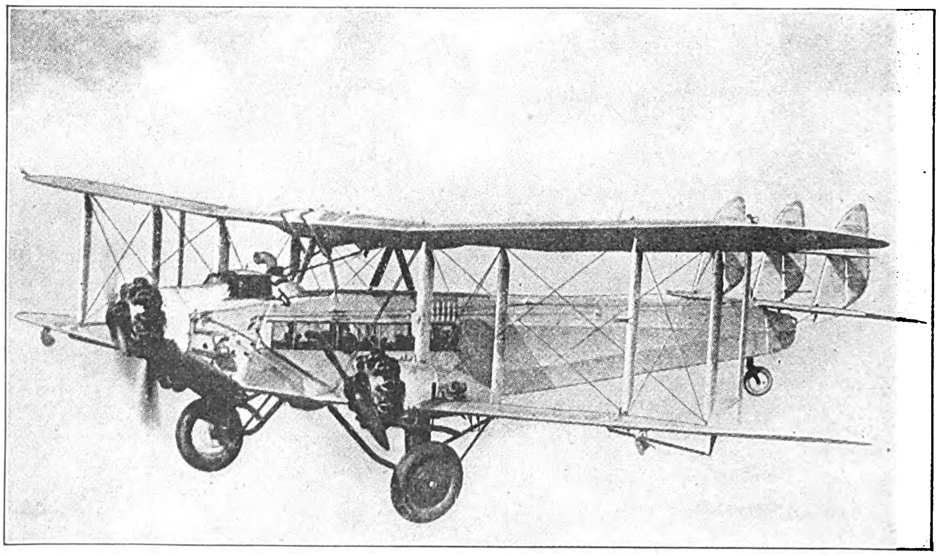
In the development of its air transport system, Great Britain has a great incentive—far flung colonies and dominions which can be connected by air and which provide airways where no competition need be feared. The De Haviland 66 is to be used, for example, on the Cairo-India leg of the Imperial Air Route from London to Australia.

It is interesting to study the De Haviland machine as an example of British practice. With English conservatism, the designer keeps to the biplane type of construction, with a moderately thin wing and a two bay truss on each side of the fuselage. To American observers, such design is none too clean aerodynamically. There are quite a number of projecting struts and wires in the tail groups, for example, with its biplane horizontal surfaces, and three fins and rudders. The whole tail unit is hinged about the front spar of the lower stabilizer for trimming purposes. An innovation which is being used in American practice where a biplane tail is employed, is to trim by movement of one horizontal surface only.

The fuselage is composed of steel tubes, in straight lengths, with mechanical joints and swaged rod bracing. This again is in contrast to American practice, where welding is allowed by Governmental authorities, and all mechanical joints as well as wires and fittings are eliminated, giving greater simplicity, and more permanent alignment of the fuselage.

It is surprising to learn that in a machine as large as this a rubber compression system is still employed. In American practice, the oleo shock absorber system is well nigh universal and provides better shock absorbing qualities and less danger of rebound in faulty landings.

The De Haviland 66 is nevertheless a rugged and entirely serviceable plane, which with its three 450 horsepower Jupiter engines attains a speed of 130 miles per hour. The main fuel tanks are carried in the top center section, the wing being thickened to accomodate the large tanks. Apart from the fuel tanks, each engine is arranged as a separate unit, complete with its own oil tank, oil tank cooler, and instruments. There is accommodation for two pilots seated in the nose and fourteen passengers, although the cabin can be arranged for seven passengers and mail and freight. In the hot countries where the plane flies, particular attention has to be paid to ventilation. The open funnel shown in the photograph is evidently an air-scoop.



A De Haviland 66 flying with one motor stopped. Note ventilator for cabin

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

The Danger From X-Ray Films

THE Cleveland disaster due to the burning of X-ray films, with the subsequent development of a highly poisonous gas, has aroused the interest of the world. When the first newspaper reports of the Cleveland catastrophe were issued, the toxic effects were attributed to what were described as heavy brown fumes of bromine gas and to various other toxic gases. To chemists familiar with the decomposition of nitrocellulose, it seemed certain that the brown fumes were those of nitrogen tetroxide.

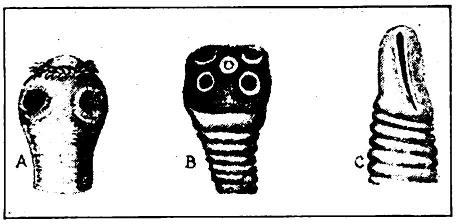
The inflammable type of film is prepared from nitrocellulose, or nitrated cellulose, as it is frequently called; the substance is one quite familiar to those who have studied explosives and the effects of their gaseous by-products. When the product is subjected to combustion—or "explosion"—there are produced, among other substances, carbon monoxide and nitric oxide (NO). Nitric oxide, even in air, quickly takes on oxygen, forming nitrogen dioxide (NO_2) or its polymer, nitrogen tetroxide (N_2O_4)—the form in which it exists depending on the temperature. All students in first year chemistry recall the preparation of this dark brown substance, dense, but not nearly so heavy as bromine gas.

The nitrogen tetroxide, as well as any unoxidized nitric oxide(1), readily reacts on the lungs and with the hemoglobin of the blood. Deaths from inhalation of so-called nitrous fumes have been reported many times. In one case, a carboy of nitric acid to which contaminants had been added accidentally exploded, yielding brown fumes of oxides of nitrogen. Firemen and policement rushed in only to succumb, some almost immediately, others hours later, to the effects of the toxic nitrogen tetroxide. Of a similar nature were the experiences during the World War of some of the observers of the effects after explosions of nitrocellulose.

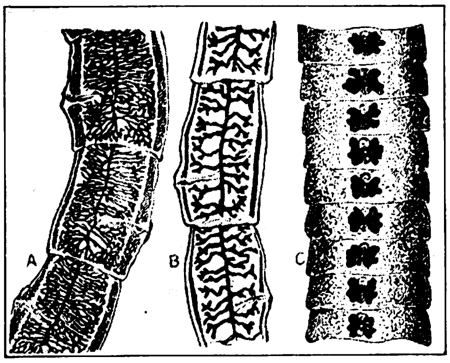
Films do contain salts of silver, particularly silver bromide, but the amount of bromide present, particlarly in developed films, is relatively small; even so, it seems unlikely that the conditions would be such that the stable silver bromide could be broken up sufficiently to yield bromine gas in anywhere near the toxic quantities reported. Films are also produced by various combinations of organic substances; synthetic camphor is used in making some types. It will be recalled that the reports of the Cleveland disaster emphasized the fact that the odor of camphor was present during the terrible calamity.

To sum up, it is apparent that in the complexity of fumes which may be given off during ignition of a large collection of both old and new films there is a possibility of the presence of the toxic carbon monoxide and nitrogen tetroxide as well as of other toxic or irritating substances. It appears unlikely that bromine could develop in amounts sufficient to be of importance.

There are two general classifications of films—inflammable and non-inflammable. The non-inflammable—a "safety" film—does not contain the nitrated group; hence it is slow burning and the hazard of combustion is minimized. The chief disadvantages of the non-inflammable over the inflammable film are stated to be the increased cost of the former and the tendency to roll and curl. The fire hazard of storing Roentgen-ray films, particularly the inflammable type, has been recognized for some time. In fact, all hospitals provide special rooms and special apparatus for storing, although the conditions vary from hazardous to safe. There is need for constant vigilance.



Above: Differential characteristics of the heads of the three principal types of tapeworm infesting man. (From French's Index of Differential Diagnosis, ed. 3, 1920, p. 519.) *Below:* Differential characteristics of the adult segments. Note the rosette shaped uterus of the fish tapeworm C; the few, coarse, branches in the uterus of the pork tapeworm B; and the many fine lateral branches of the uterus of the beef tapeworm, A. (From Barker's Clinical Diagnosis of Internal Diseases, 2:438; 1919.)



Fish Tapeworm Infestation

PREVIOUS to 1906, infestation of persons in the United States with the fish tapeworm was exceedingly rare. About that time, Warthin of the University of Michigan pointed out that the waters of the Great Lakes and of the smaller lakes in the vicinity were being contaminated with the fish tapeworm and that an increasing number of cases might be expected among Americans in the vicinity. Innumerable cases have now been collected by many investigators. It is interesting to know that the early cases were found among people who had come from Finland and other Scandinavian countries and that one out of every five persons in Finland is a subject of the disease.

Dr. Moses Barron has recently called attention to numerous cases seen in Minnesota. Whereas the cases seen from 1911 to 1919 were primarily among Finns, Swedes, and Americans, the majority of cases seen since that date have been among Jewish people, primarily women. Doctor Barron's explanation is that the infestation of the women is due to their tendency to taste the raw fish while they are preparing the dish commonly called "gefüllte fish." This dish consists of minced raw fish carefully seasoned before boiling. In order to make sure of the proper seasoning, the housewife tastes the minced raw fish repeatedly before it is finally cooked. During this tasting process she becomes infested with the eggs of the tapeworm.

When the condition occurs in children, it is apparently due to the fact that the child comes into the kitchen and is given a taste of the raw fish.

The prevention of the condition is clear. It involves cleaning up the water in which the fish are infested and urging thorough cooking of fish before eating.

Constitution and Reproduction

THE great trend of modern medicine is toward a study of the individual human being as a whole, taking into account heredity, constitution, and environment, rather than the diseased state of any individual organ. One of the most important aspects of this investigation of mankind has to do with the power of reproduction.

In a significant consideration, Dr. Samuel R. Meaker of the Boston University School of Medicine found that failure to reproduce was in most instances due to many causes rather than to a single cause; that in the majority of cases constitutional factors depressing the fertility of one or both partners were operative. It is significant that the incidence of constitutional faults is greater in the male than in the female. Hence a study of the failure to reproduce involves not only a careful investigation of the physical capacity of the sex organs, but also a very complete study of the constitutional states of both the husband and wife.

In many instances bad functions of the glands, and insufficient diet, particularly with relation to the vitamins may be found to be responsible in some part for the failure to reproduce.

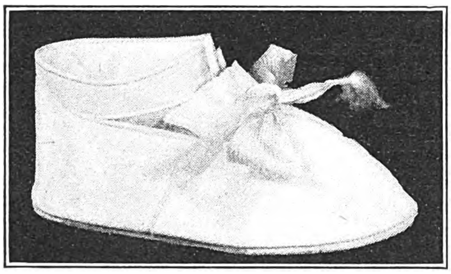
---

(1) The oxides of nitrogen discussed here do not include nitrous oxide (N_2O), which is well known to the medical profession as an anesthetic gas.

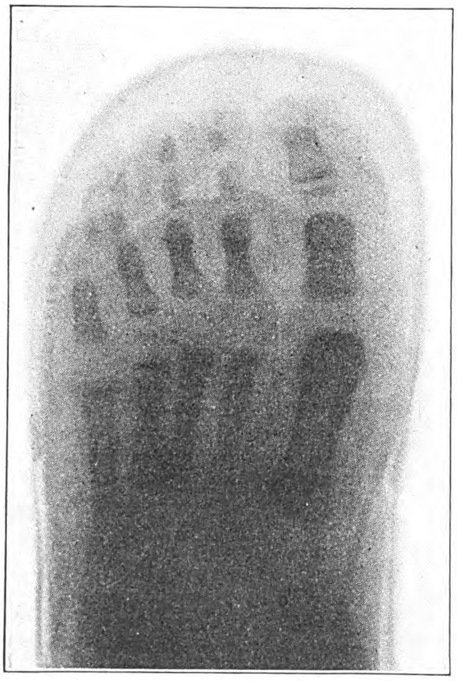
An X-ray photograph of the foot bones of an infant one week old

Shoes for the Baby

A SUBJECT of perennial interest to mothers and to orthopedic surgeons is the selection of the first shoes for the infant and the gradual change of the shoes as the foot develops. During the last great war, innumerable men were rejected for service because of flat-feet. Nowadays it is recognized that flat-feet not infrequently function fairly satisfactorily. However, there is much advantage in having good feet capable of marching 15 miles a day without strain and feet that present what is recognized as a suitable appearance.



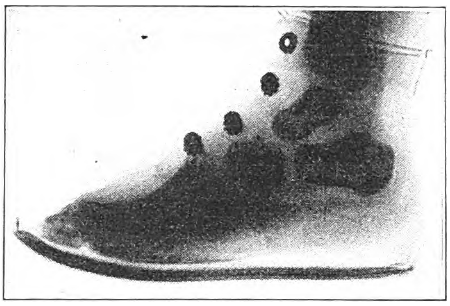
A "paper bag" shoe such as this one should be worn by an infant who is just starting to learn to walk



The X ray shows clearly how the parts of the foot in a properly fitted shoe are free and uncramped

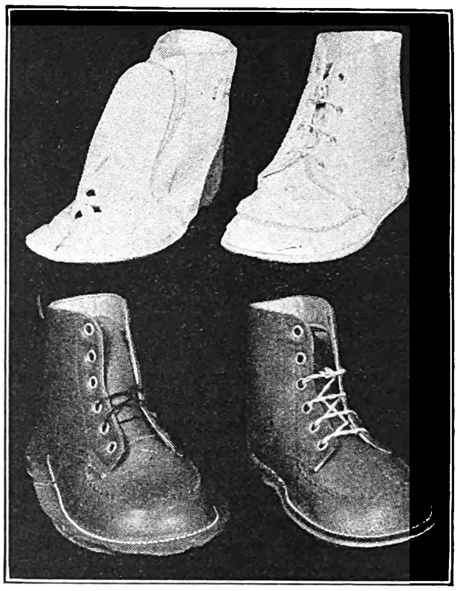
In a consideration of the subject, Dr. John D. Adams points out that far too often shoes are selected from the point of view of vanity rather than of service. He insists that the first shoes of the infant should be like a paper bag with just enough shape to make it possible to call it a shoe. The material should be soft white kid with a flexible unresisting sole and with a draw string of tape at the top.

Between the ages of two and five, the shoes must be somewhat more substantial. At this age the shoe should be sufficiently broad to allow the toes to assume a natural, uncompressed weight-bearing position, at least one half inch longer than the weight-bearing foot. It should have a well shaped heel, sufficient depth from the vamp in the middle of the foot to the middle of the sole, and a broad flexible sole with a straight outside.

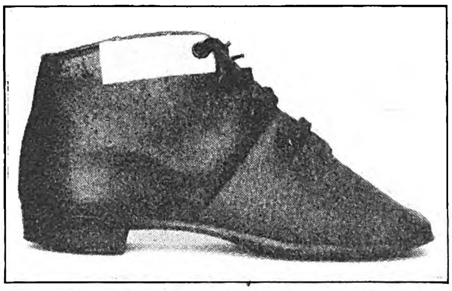


Effect of shoes that are too short, showing the beginning of flexion deformity and future trouble

Up to the age of three and one half years, the shoes should not have a heel any thicker than the sole; and from three and one half to five years, the heel should be twice as thick as the sole. In the accompanying illustrations the important points here emphasized are well brought out.



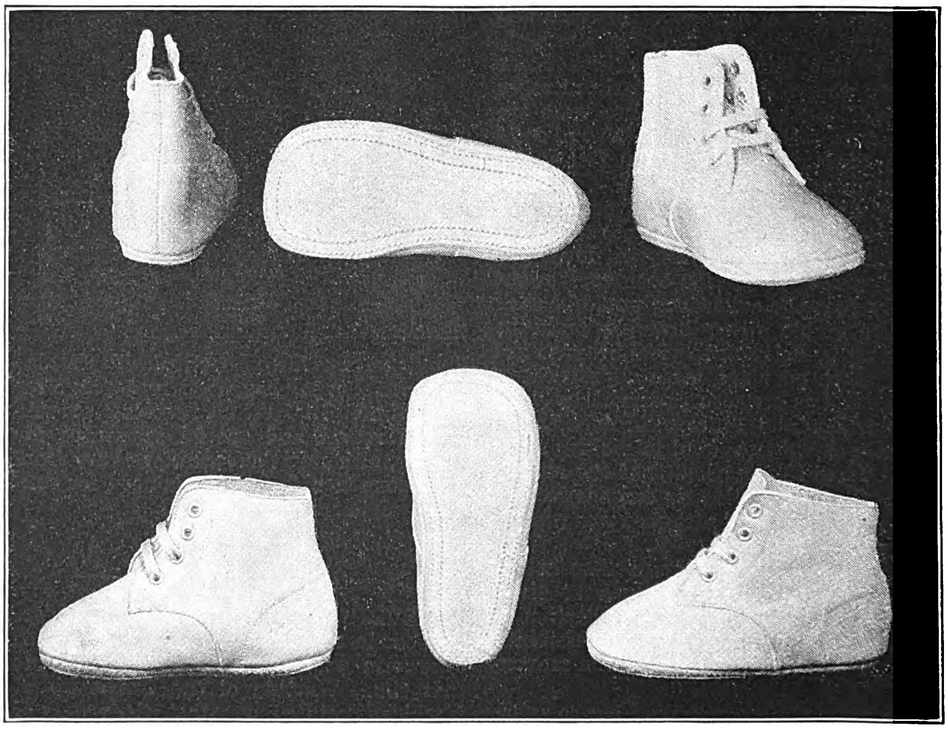
Two different types of children's shoes made with moccasin toes



An interesting relic of 100 years ago. A child's shoe from that time

Backache in Golf and in Polo

IN a brief consideration of backache occurring particularly to players of golf and polo, Dr. Horace Gray points out that this results not so much from play as from excessive and wrong golf practice. In three cases which he investigated, the ages ranged from 35 to 45 years, the side involved being the left, all of the patients being right-handed. The cause was limited definitely to the use of the irons, particularly the mashie and the niblick, in which there is a brisk snappy twist of the trunk as the ball is struck. When this stroke was repeated frequently, the result was a pain in the back. Dr. Gray insists that people subject to low back strain should be warned particularly against too much practice with the short distance clubs.



Several views of the ideal child's shoe

From dance hall floors to railway coach ceilings ..this grainless wood board

Beauty, such as paneled ceilings need, is usually required to sell a product. Durability, that a floor must have, is necessary to keep it sold. Manufacturers who adopt Masonite Presdwood find that it gives their products both durability and beauty. Samples for testing will be gladly supplied.

FOR DANCE HALL FLOORS

In a Denver dancing academy the tap-tap-a-tap of metal tipped clogs resounds from a floor of Masonite Presdwood. At Pullman, Illinois, ceilings of Presdwood are applied to railway coaches. And in scores of widely varying industries, hundreds of products are being made better and at lower cost because of this grainless wood.

Many of these Presdwood products require the strength and durability that are indicated in the service rendered at Denver. Used eight hours a day at the Fred Merritt School of Tap Dancing, the Presdwood floor showed no signs of wear, even after weeks and weeks of usage. Other Presdwood products may require smoothness and ease of finishing — there, again, Presdwood is ideal, as evidenced by its use for paneling . . . not only in ceilings of railway coaches but in fine homes and buildings as well.

Is easily cut

Beauty and lasting qualities are but a part of the advantages of Masonite Presdwood. It is moisture resisting and almost immune from warping, shrinking and buckling. It is extremely easy to work with. It can be sawed, punched, planed, milled or sanded. It is liked by shop foremen, experienced with materials of all kinds, and is just as welcome in homes where handy men put up shelving or build a radio cabinet. Wherever it is used it never harms fine tools, for it contains no artificial binder.

FOR RAILWAY COACH CEILING

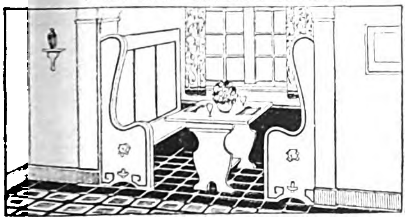
Has wide range of uses

The uses of Presdwood are many and varied. They range from bedroom screens to toys, from motor truck bodies to hydroplane hulls, from bread boxes to loud speaker tension boards, from out-door signs to kitchen cabinets, from office partitions to billiard tables, from clothes hampers to breakfast nooks.

Fully eighty of Presdwood's many uses, in industry and the home, are listed in the Presdwood booklet which is gladly sent to those who appreciate the beauties of fine materials or who wish to effect manufacturing economies with this workable grainless wood.

MASONITE CORPORATION
Dept. 740, 111 W. Washington Street
Chicago, Illinois

FOR BREAKFAST NOOKS



Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR PANELING

© 1929 M. C.

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

What Is Petroleum?

WHAT is the chemical composition of petroleum? The answer is similar to that for the question "how long is a string?" Chemists say that petroleum is a complex mixture of various hydrocarbons, and readily identify a number of these compounds, composed of different combinations of carbon and hydrogen. In the commercial distillation of petroleum, the oil is broken up into five fractions known as naphtha, kerosene, gas oil, wax distillate, and bottoms. Each of these fractions may be further subdivided by additional refining, a great variety of well known and indispensable products resulting.

An examination, however, of the literature on the composition of petroleum discloses the reported existence of a large number of different hydrocarbons to which formulae and values of physical properties have been assigned. A study of the evidence presented in identification of these "compounds," however, impresses one chiefly because of its inadequacy. "In fact," says Edward W. Washburn, of the United States Bureau of Standards, "with the exception of some of the lower boiling constituents, most of the compounds whose existence has been reported must be classed as purely fictitious in the light of the evidence at present available."

The United States Bureau of Standards is now conducting experiments to determine just how the atoms of hydrogen and carbon are hooked together in the various fractions of petroleum. The task presents many difficulties, for the atoms are prone to rearrange themselves on slight provocation so that the products driven off by the usual distillation method may have been present originally or may have been formed during the distillation—one never knows. Accordingly, it has been necessary to develop the special still shown in the illustration. The asbestos-covered pot in the center, surmounted by the tall rectifying column, contains the petroleum fraction to be tested. The temperature of the oil in this still pot is kept constant and low enough to avoid cracking, while distillation is compelled to proceed by passing a fine stream of hot carbon dioxide bubbles through the oil. The distillates are conducted through the rectifying column and thence through a series of condensers kept at progressively lower temperatures down to -80 degrees, Centigrade.

With the aid of this apparatus the Bureau hopes to be able to answer with scientific precision the question: "What is petroleum?"

Sulfur in Air Attacks Drying "Wash"

IF you would have your cotton goods last longer, do not leave the wash hanging on the line over night. This is not a warning against light-fingered hoboes who might take a fancy to a shirt hanging "all by itself in the moonlight" but against an odd nuisance that is known to laundry men as "winter damage." In tests now being conducted by J. J. Wilkie of the United States Bureau of Standards it was found that during typical "winter damage" weather, overcast days in the winter time, wet towels took up sulfur dioxide when exposed in ordinary city air in Washington, D. C., and became acid in reaction. This did not occur on clear, dry days, but often did occur when the towels were hung out overnight.

The fact that the damage is found only in wet wash, which is returned to the customer to be dried and ironed, led to a comparison of the effect of home finishing with laundry finishing. It was found that the breaking strength of towels which were repeatedly washed, dried outdoors, and ironed by hand decreased faster than the breaking strength of similar towels washed at the same time and finished in the laundry.

This deterioration may be attributable in part, at least, to atmospheric sulfur dioxide. This was shown by exposing damp towels to air containing one part per million of sulfur dioxide, ironing, moistening the towels and repeating the treatment. Towels processed in this way decreased in strength at about the same rate as towels which were washed in the laundry, hung outdoors, and dried. Towels containing small amounts of iron deteriorated much faster than towels containing no iron. Very small amounts of chlorates, or of soap mixed with sodium hypochlorite, such as might remain in the goods from the laundry, also promoted deterioration of towels when exposed to air containing sulfur dioxide. Sulfur dioxide in cloth is readily oxidized to sulfuric acid, which is injurious, especially when heated, as when the cloth is ironed.

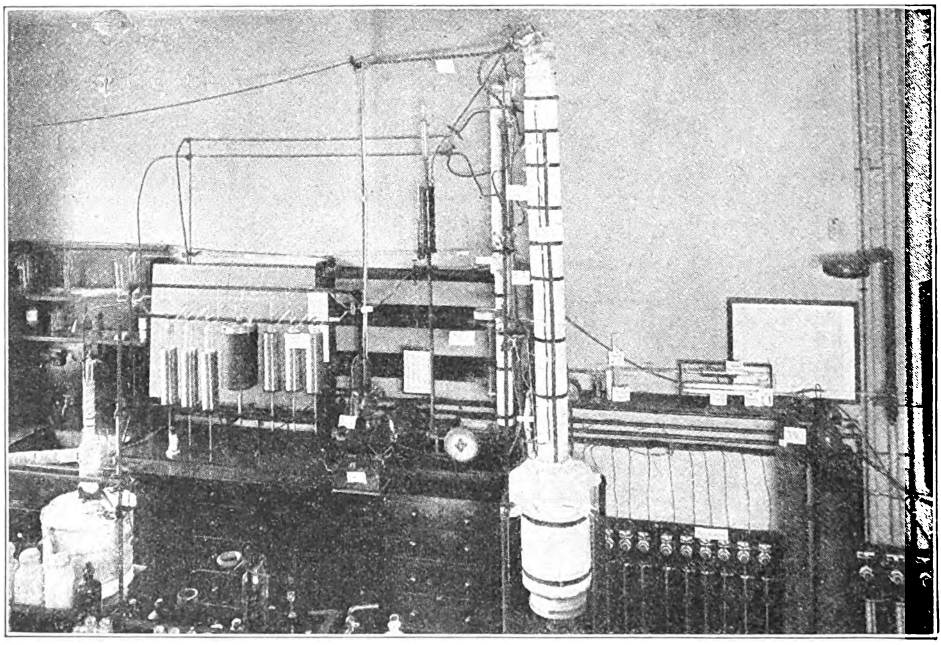
Chemical Belt Dressing Eliminates Static

DISCHARGES of static electricity, built up by moving belts, occasionally result in disaster when the discharge takes place in the presence of inflammable vapors or gas. P. W. Edwards and J. O. Reed, of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, have recently developed non-static belt dressings which eliminate this threat of static electricity.

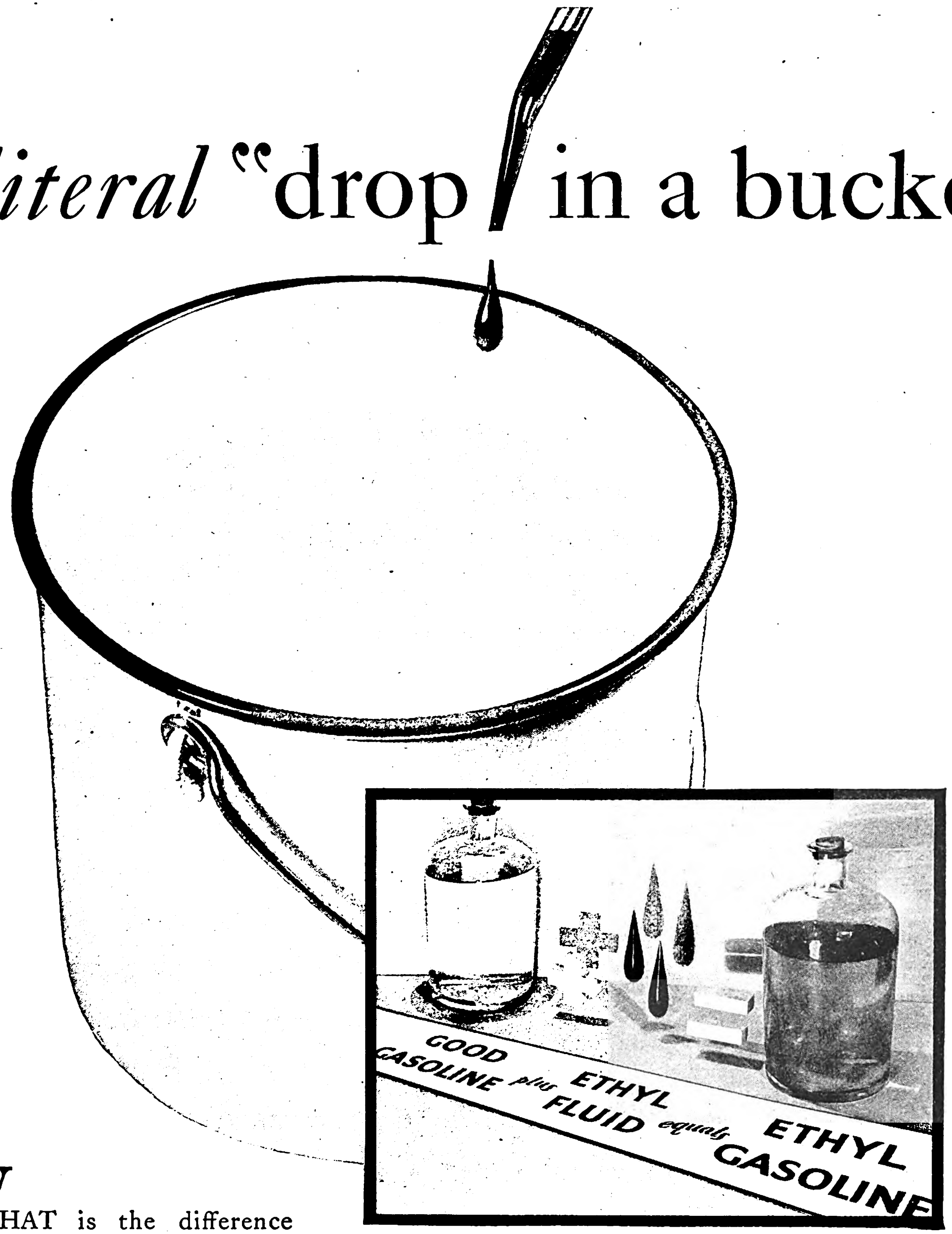
The requirements for a non-static belt dressing are as follows: (1) It must have sufficient electrical conductivity to remove or neutralize static electrical charges as rapidly as they are formed; (2) it should be of such a nature that it can be easily applied; (3) it should resist wear; (4) it should not decrease the coefficient of friction of the belt on the pulley; and (5) it should not be injurious to the belt.

A good rubber belt dressing can be prepared by mixing 18 parts of lamp black with 82 parts of good spar varnish. A smaller quantity of lamp black may prevent most of the cracking which develops after the above dressing is used for several months. The dressing must be allowed to dry on the belt before the belt is used. A non-inflammable thinner for the varnish can be prepared by mixing equal volumes of carbon tetrachloride and varnish makers' and painters' naphtha.

A non-static leather belt dressing which has considerable merit consists of 100 cubic centimeters of liquid fish glue, 80 cubic centimeters of glycerine, 100 cubic centimeters of sulfonated castor oil, 170 cubic centimeters of water, 82 grams of lamp black, and 20 cubic centimeters of



An improved rectifying still at the Bureau of Standards laboratories in Washington for determining the exact composition of petroleum distillates. Carbon dioxide from the tanks at the right is bubbled through the oil to promote distillation. Between the tanks and the asbestos-covered still, to which the rectifying column is attached, is a series of rheostats for controlling the 20 electric plates used to study the composition at various heats


GOOD GASOLINE plus ETHYL FLUID equals ETHYL GASOLINE

A *literal* "drop" in a bucket"

WHAT is the difference between any good gasoline and Ethyl Gasoline? In one sense very little. Ethyl *is* good gasoline with just a little Ethyl fluid—less than a teaspoonful to a gallon—mixed with it.

The great difference between the two lies in the performance they get out of an automobile engine. So effective is that small amount of Ethyl fluid that it eliminates the "knock" from your engine and puts to work that power which is wasted with ordinary gasoline.

Ethyl fluid was developed by automotive science to eliminate the "knock" and power loss which occur when ordinary gasoline is compressed beyond a certain point.

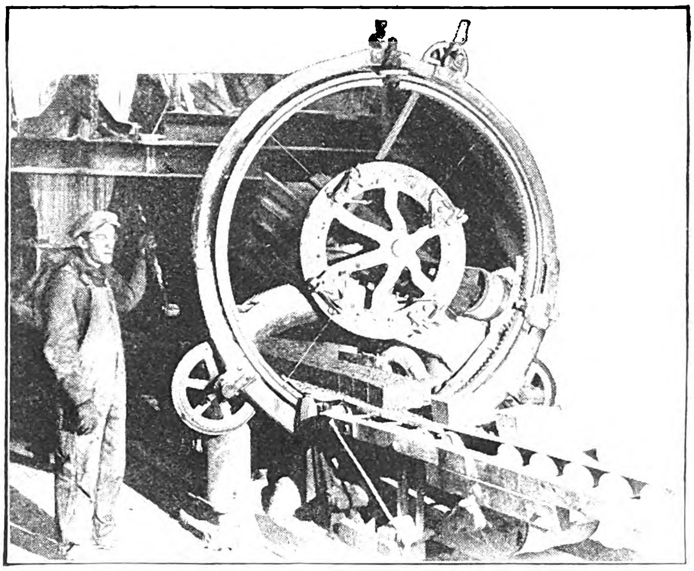
A high compression engine needs fuel of Ethyl's anti-knock quality if it is to do its best. And Ethyl gets out of engines of average compression additional power impossible to obtain with ordinary gasoline.

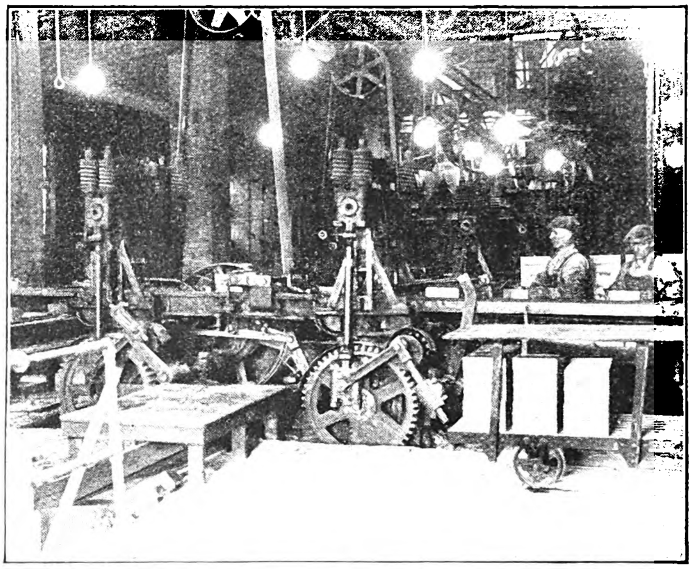
Start riding with Ethyl today. See the difference it makes.

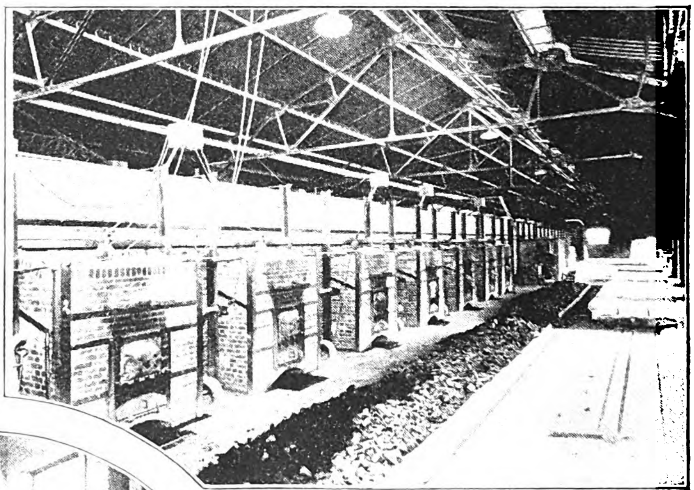
Ethyl Gasoline Corporation,
25 Broadway, New York City;
56 Church Street, Toronto, Can.;
36 Queen Anne's Gate, London, England.

ETHYL GASOLINE

© E. G. C. 1929

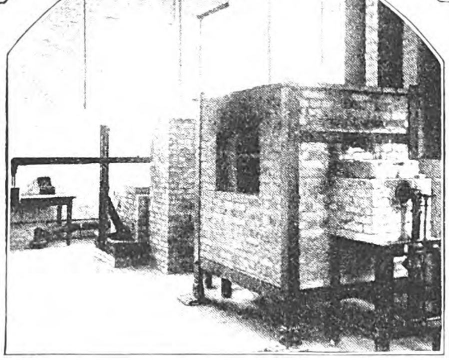






At the top of the illustration is shown a machine for cutting a strip of fireclay brick into small blocks. *Below:* After sizing, the bricks are placed on trucks which roll into the drying kilns, warmed by means of waste heat from the kilns in which the refractory bricks are "burned" scientifically

Top: After the bricks have been cut into blocks they are transported by an automatic conveyor to this patented sizing machine, which insures refractories of uniform size and shape. *Below:* Kilns in a modern plant, where refractory bricks are fired with carefully controlled temperature and humidity



Furnaces in which refractory bricks are tested to determine their ability to support the usual load

two percent ammonium hydroxide. These proportions may not be the best for all conditions. In some cases better results will probably be obtained by increasing the quantities of fish glue and glycerine. It may be easily applied with a brush while the belt is moving. It is not necessary for this dressing to dry before running the belt. If the belt has not been properly maintained this dressing will cause it to stretch.

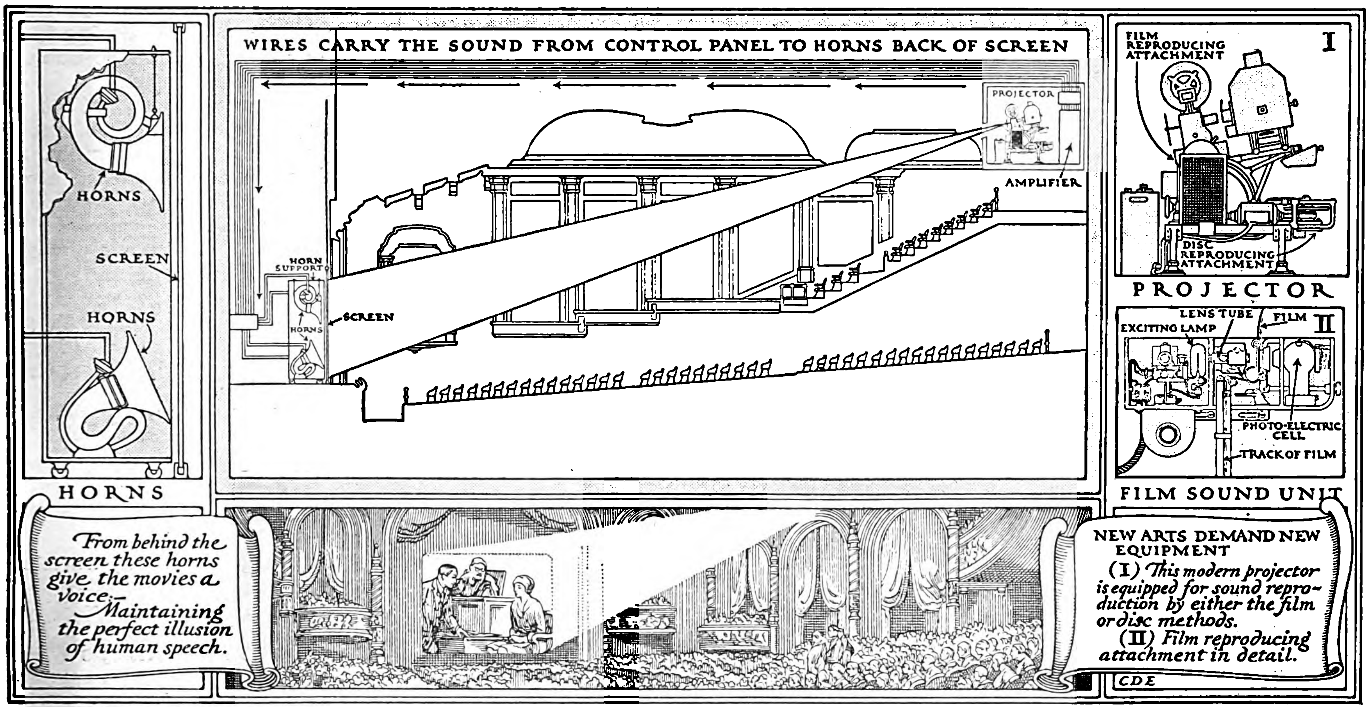
Chemistry Contributes to Better Bricks

THE ancient proverb to the effect that you can't make bricks without straw has been succeeded by modern recognition of the fact that you can't make good bricks without chemistry and scientific precision. If you require bricks merely to throw at somebody you need not be fussy about the specifications, but if you happen to be building a boiler setting or a furnace wall you will do well to select a refractory brick which is the product of careful scientific manufacture and technical control.

Recent innovations in the manufacture of refractory brick are described by L. J. Trostel, Chief Chemist of General Refractories Company in *Chemical and Metallurgical Engineering.* Instead of being limited to fireclay brick, says Mr. Trostel, the user of refractories now has the additional choice of magnesite, dolomite, chromite, silica, diaspore, mullite, kaolin, silicon carbide, zircon, and corundum. It is further significant that the actual tonnage of refractories now produced in the United States is not greatly in excess of what it was in 1920—in spite of the rapid growth of the consuming industries and increasingly severe service conditions. The answer, of course, is that the quality of refractories has been so improved that they will withstand the higher temperatures and faster production schedules of modern industry.

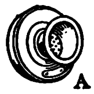
Several advances in the processing of refractories have distinctly improved the quality of the product. Originally, refractories were hand-molded, dried, and burned under rule-of-thumb control. Then, as in other branches of the ceramic art, successful production was entirely dependent upon the personal skill and judgment of a few men in the plant. With the introduction of other types of refractories and methods of manufacture, there came a new type of thinking that helped to change the industry from a craft and place it on a scientific basis.

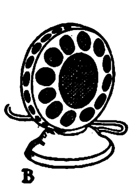
The trend continues, for research now in progress has revealed further possibilities of improvement in the drying and burning of silica, magnesite, and chrome brick, of casting refractories of definite composition and structure from the fluid melt of an electric furnace, and finally, of scientifically building up a brick of accurately sized particles in order to furnish a product of maximum denstity and minimum voids. New materials of high refractoriness, which have been hitherto unused because they lacked volume stability at high temperature and under load, have been successfully modified to meet industrial conditions. Other desirable effects have been attained by burning in atmospheres of definite composition.

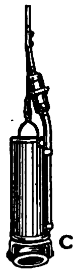

WIRES CARRY THE SOUND FROM CONTROL PANEL TO HORNS BACK OF SCREEN
PROJECTOR
AMPLIFIER
HORN SUPPORT
SCREEN
HORNS
HORNS
SCREEN
HORNS
HORNS
From behind the screen these horns give the movies a voice—Maintaining the perfect illusion of human speech.
FILM REPRODUCING ATTACHMENT
I
DISC REPRODUCING ATTACHMENT
PROJECTOR
LENS TUBE
FILM
EXCITING LAMP
II
PHOTO-ELECTRIC CELL
TRACK OF FILM
FILM SOUND UNIT
NEW ARTS DEMAND NEW EQUIPMENT
(I) This modern projector is equipped for sound reproduction by either the film or disc methods.
(II) Film reproducing attachment in detail.
CDE

WHAT MAKES THE PICTURE TALK?

Your enjoyment of a Sound Picture depends largely on the quality of apparatus used. It pays to go to theatres equipped by the makers of your telephone — the Western Electric Company


A


B


C

WHEN you go to hear a Sound Picture you wish to be certain that the voices will be clear and natural; that the musical accompaniment and the sound effects coming from the screen will be thoroughly pleasing.

Near you is probably at least one theatre which assures just that, because it is equipped with the Western Electric Sound System. This apparatus, made by the makers of your telephone, is installed and inspected by engineers trained in this new art.

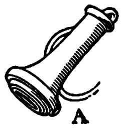
The reliable quality of this Sound System has been recognized by over 2,000 theatre exhibitors — exhibitors who have a habit of considering their patrons' satisfaction and who therefore believe that it is worth a little extra investment to secure equipment of proved results.

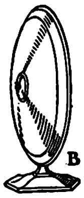
In selecting Western Electric these exhibitors knew that the correct transmission and reproduction of sound is an extremely difficult problem, as is evidenced by the wide differences in quality between various radios and phonographs. They knew that it was Western Electric's experience with this very problem which, after years of unsuccessful effort by others, finally made Sound Pictures possible.

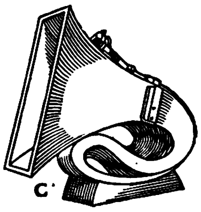
This same organization which brought the telephone to its present excellence will likewise constantly seek to improve Sound Picture apparatus still further.

To Theatre Exhibitors

People know good Sound reproduction when they hear it. They are quick to appreciate the high quality assured by Western Electric equipment. If your theatre is thus equipped you will render a service by displaying that fact in your advertising and in lobby and outside signs. For additional information address Electrical Research Products, Inc., 50 Church Street, New York.


A

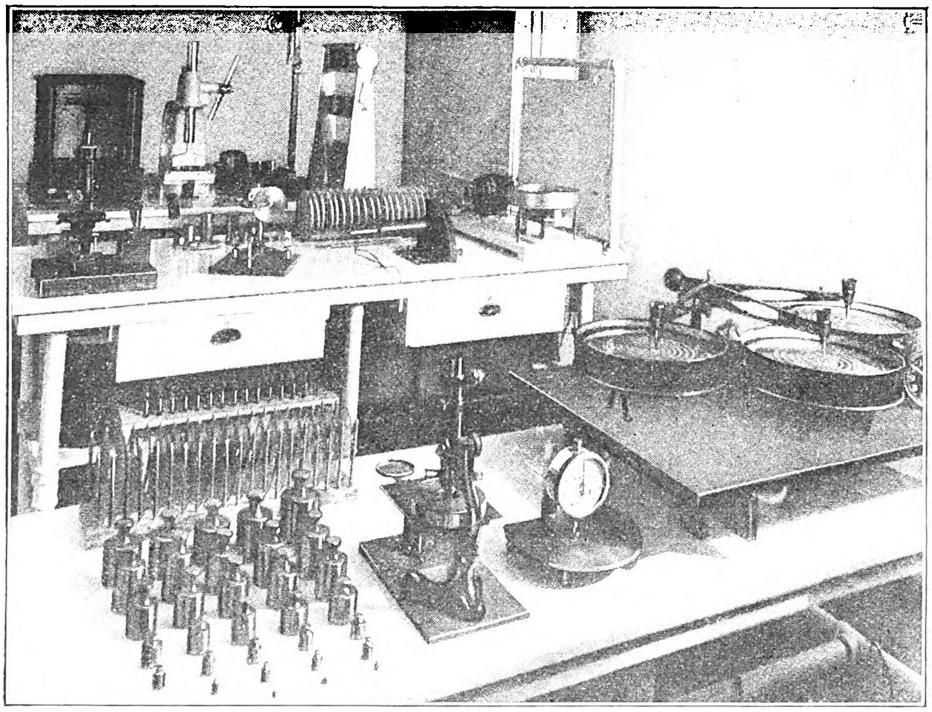

B


C

The sensitive Sound Picture microphone (C), designed for studio recording. A development of the broadcasting microphone (B) and the telephone transmitter (A), indicating how "Sound Pictures came out of the telephone."

Western Electric
SOUND SYSTEM
THE VOICE OF ACTION

The loud-speaking horn (C), a marked improvement for Sound Picture purposes over the cone loudspeaker (B). It is a direct descendant of the familiar telephone receiver (A), and is made with the same care.



Paint and varnish testing laboratory at the Experimental Station of E. I. du Pont de Nemours and Company at Wilmington, Delaware. The drying-time meter, shown at the extreme right, has three cones depositing spiral trails of sand on drying films of paint. Other apparatus shown includes hardness testers, a film thickness gage, surface tension apparatus, print tester, an instrument for measuring gloss and a device for making paint films

Unique Instruments Test Properties of Paint

PSYCHOLOGISTS may be able to explain why the familiar sign "Wet Paint" creates an irresistible impulse in passers-by to touch it with doubting finger-tips. The paint chemist, however, is not satisfied to judge degree of dryness by such a simple procedure, and has devised ingenious instruments for determining with scientific accuracy just how long it takes a paint film to pass through progressive stages of dryness. One of these drying time meters is shown in an accompanying illustration. It consists of a rotating disk, like a glass phonograph record, on which is laid a coat of fresh paint. A small cone, suspended over the disk and moved slowly horizontally while the disk rotates, drips a special trail of fine sand on the paint film. After the paint is dry, the disk is tapped sharply on the back, the loose sand flys off and reveals the exact point at which the paint became too dry to make the grains adhere.

Drying time is only one of the properties of paint that must be controlled and studied in the chemists' quest for better protective coverings. Hardness of the dry film is equally important, and apparatus for testing this property is also shown in the photograph, taken in the Experimental Station of E. I. du Pont de Nemours and Company, Wilmington, Delaware. One of the first investigations made with a quantitative hardness tester revealed the fact that two out of four products tested actually became softer, rather than harder, as time went on, according to D. V. Gregory, writing in the *du Pont Magazine*. The weather reports for this period showed that humidity had increased. In other words, the effect on the film of increasing the humidity was greater than the rate of drying. Not until the humidity dropped again did these products harden.

Later results under carefully controlled atmospheric conditions showed increasing hardness of these same products with time. Other tests showed that in some cases raising the temperature 20 degrees, Fahrenheit, caused the films to soften to one tenth of their former value. In a series of products tested, none of them was harder at elevated temperatures. In the case of humidity, the effect is not so great as with temperature, but a 25 percent increase in relative humidity decreased the hardness to one fifth the original value. Relative humidity may be defined as the percentage of moisture in the air at any one time, compared to the amount of moisture in saturated air at the same temperature.

Temperature and humidity also affect the drying time, although not so much as they do hardness. For example, dropping the temperature from 77 degrees to 42 degrees, Fahrenheit, and raising the relative humidity 35 percent, in a number of cases caused a slowing up of drying to one third, and in a few instances to one fifth and one tenth the former rate.

These same factors also affect the elongation and tensile strength of protective coating films. For example, the elongation of a film in a saturated atmosphere—100 percent relative humidity—may be as much as 60 percent greater than is the case with an absolutely dry film. Under these conditions the tensile strength may decrease to one tenth the former value. A 10-degree increase of temperature may raise the elongation to as much as 10 percent and lower the tensile strength 25 percent.

It is obvious that humidity and temperature are important factors in the behavior of paint films. In order to control these variables, du Pont chemists carry on such investigations in a room where both temperature and humidity are kept exactly the same all through the year by automatic air conditioning equipment.

'Stickum'' For Stamps

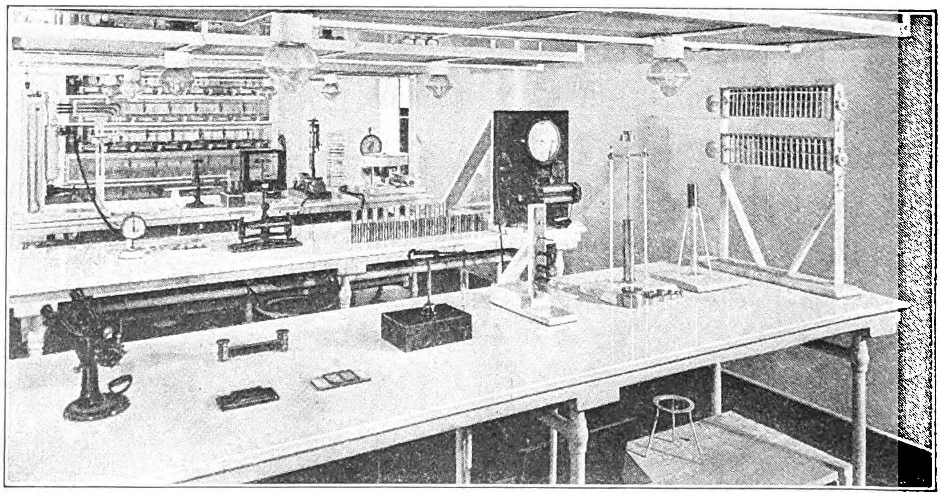
VICTOR G. BLOEDE, president of a Baltimore company which bears his name, is the man who makes the postage stamp gum for the government. His is no ordinary business, and it has a fascination for the layman. The finished product must be wholesome enough for a baby to eat, strong enough to hold up against wear and weather, and thin to the vanishing point.

The base is tapioca starch from Java. Roasted, powdered, and treated with chemicals, this becomes a fine cream-colored powder, and in this form it is shipped to Washington by the carload. Something like 1,000,000 pounds of this cream-colored powder is used by the government every year.

Scientific Dish Washing

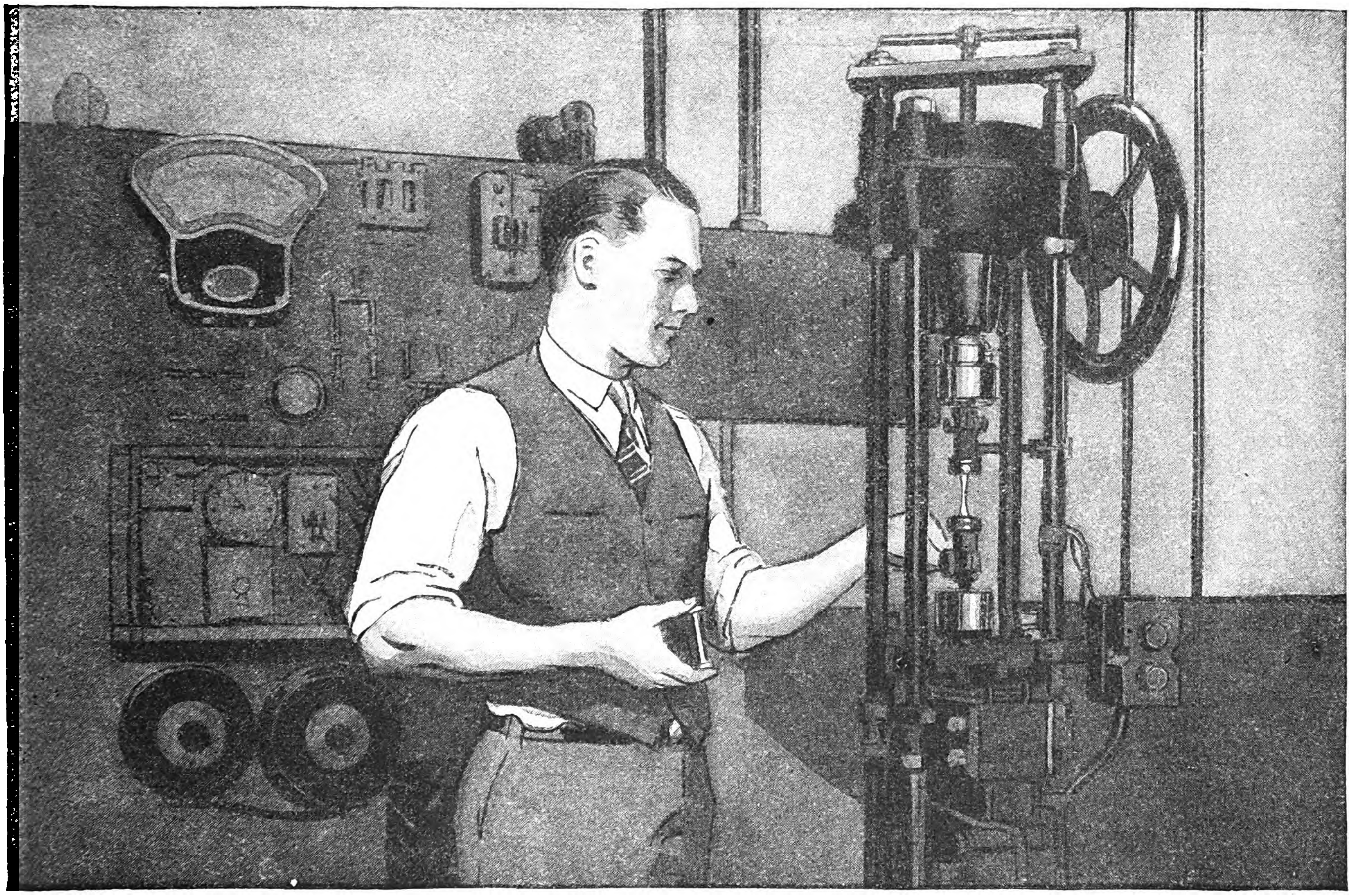
IN restaurants, cafeterias and hotels, washing the dishes is just as drudging a job as at home—unless the chemist and dishwashing machine man are called in to help. The commonest way of washing dishes in these establishments is to use a big pan full of hot water with some heavy

(*Please turn to page* 183)



Temperature room of the du Pont company's Central Technical Laboratory in Philadelphia. The temperature and humidity in this room are controlled and regulated to eliminate almost all variations. This is done with automatic air conditioning equipment, refuting Mark Twain's comment that "Everybody talks about the weather, but nobody ever does anything about it"

WHAT WESTINGHOUSE IS DOING IN RESEARCH



WESTINGHOUSE ENGINEERS HAVE DEVELOPED SPECIAL MACHINES IN WHICH THEY MEASURE THE DYNAMIC STRENGTH OF MATERIALS UNDER ACTUAL SERVICE CONDITIONS

Feeling the muscles of metals at work

"Feel my muscle," challenges the proud urchin, "I can lift fifty pounds." But set that same youngster at work and his lifting ability quickly dwindles.

So it is with metals. A test bar of steel may register a strength of fifty thousand pounds in a common laboratory testing device. Yet a shaft of the same material in a whirling, vibrating machine might fail if loaded half as much.

Westinghouse engineers must know exactly how strong metals are when at work. To find out they have developed testing machines that whirl shafts and jiggle them while they measure their strength within a fraction of a pound.

They have built machines also that test the strength of metals under the corrosive action of wet steam, and that measure the amount of permanent deformation which may result after long service at high temperatures.

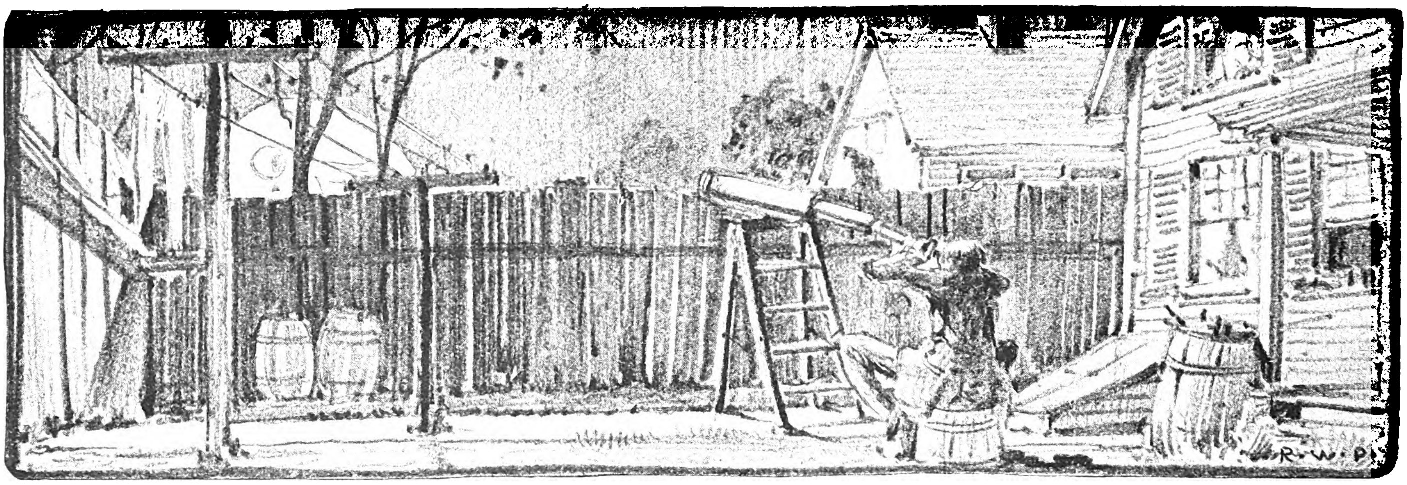
With the knowledge gained from these dynamic testing machines they have been able to cut down the bulk, the weight and the vibration of electrical machinery without sacrificing reliability.

Westinghouse, through untiring research into every factor of principle and design, continually leads the way to new economies and improvements in electrical equipment.

The Sign of a Westinghouse Dealer

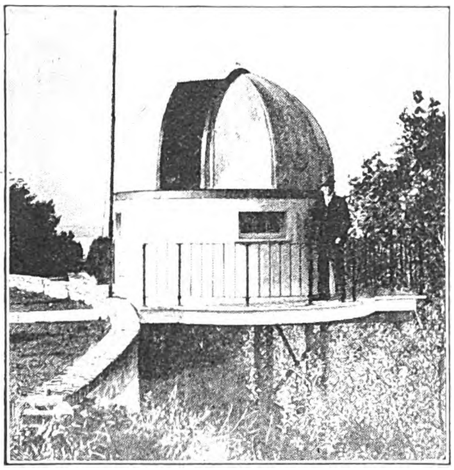
Westinghouse
Electrification
Appliances Apparatus
Wiring
W
WESTINGHOUSE ELECTRIC

Westinghouse



The Amateur Astronomer

SOME pretty swank looking telescopes have been turned out by some of the readers who have caught the germ of the amateur telescope making disease. Looking over the dozen or more descriptions which we have on file for future publication, this impression is greatly strengthened. One of the most trim jobs we have seen is that of Mr. H. B. Ross of the Ross Carrier Company at Benton Harbor, Michigan. Mr. Ross' letterhead indicates that his company manufactures motor driven carriers, those odd-looking but very practical gasoline or electric trucks which, with wheels mounted on tall legs, run up to a pile of lumber, straddle it, pick it up bodily and run off with the whole pile without a stick being separately handled.



Mr. Ross and his observatory, with Lake Michigan visible just at the left, through the trees

"I enclose," writes Mr. Ross, "some prints of a 12-inch reflecting telescope I made with the help of your wonderful book 'Amateur Telescope Making.' About a year ago I picked up a volume of Flammarion's 'Popular Astronomy,' and after reading it determined to have a telescope and purchased a 4½ inch Zeiss instrument with a triple lens objective. I then subscribed to the Scientific American in order to get the monthly star maps. Thus I discovered you had a department devoted to this delightful hobby and got a copy of 'Amateur Telescope Making' at once. It proved to be a valuable treatise.

"I made an 8-inch mirror first, to get some experience, and then tackled the 12-inch. It is remarkable how everything behaved just as the book explained, throughout the successive stages of grinding, polishing, and figuring the concave mirror. For grinding I rigged up a machine driven by a washing machine motor. This had a variable stroke, either straight or elliptical, and an adjustable feed for rotating the glass disks in opposite directions. It worked very well. [For the information of new readers, all the work is generally performed by hand.—*Editor*.] However, I did most of the polishing by hand. A true paraboloid showed up before the polishing was half completed. A hyperboloid next gave a little trouble, and later a central hill had to be removed before getting the mirror back to a true figure.

"The focal length is 110 inches. I get a range of magnification of from 55 to 458 diameters, using various eyepieces. The definition is good; in fact it compares very favorably with that of the Zeiss telescope, which is a high grade instrument. The mounting is a combination of alt-azimuth and equatorial; we live on the shore of Lake Michigan and the equatorial is not so convenient for sweeping around the horizon. I now have the Zeiss refractor mounted on the same equatorial head and the combination makes a good appearance.

"The observatory is 12 feet in diameter and is built over the edge of a bluff 85 feet above the lake. The inside rests on a concrete retaining wall, and the outside is supported on heavy steel columns."

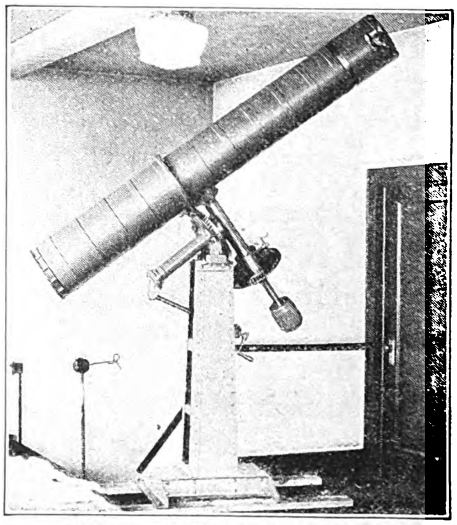
DR. BERT R. CARLSON, dentist, 4100 East Lake Street, Minneapolis, Minnesota, sends in several photographs of an especially neat appearing telescope completed by him. "The patterns for the castings," he writes, "were made at home but I performed the machine work at the shop of a former employer. Everything is brass except the tube and the ⅞ inch steel shafts. For the purpose I found that brass tubing was not stiff enough.

"The mounting without tripod weighs about 40 pounds and is none too heavy. It is intended for a column on a concrete base, which I hope will make it more steady. The declination and hour circles are part of the friction plates. The slow-motion member holds the vernier.

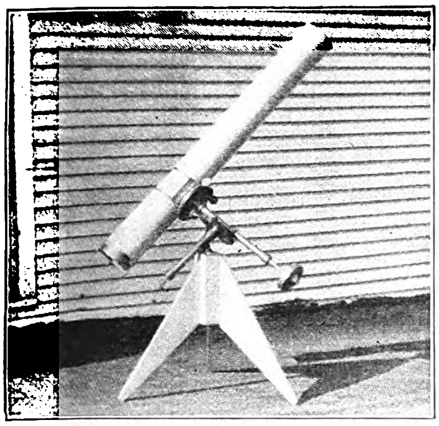
"I enjoyed the polishing. My first pitch lap was too soft and by the time I had learned to interpret the shadows in the shadow test the speculum was deeply hyperbolized, with a hole in the center that could be seen before the knife-edge cut off the light. It required seven hours and two pitch laps to bring it back to a sphere, but I learned a lot about shadows, strokes, and so on, in doing it. I believe it is better not to get a parabola by beginner's luck the first time, but to have to work for it. The instruction one thus gets is worth the effort.

"The mirror has a focal length of 53 inches and the entire instrument cost less than 50 dollars."

THE Fourth Annual Convention ("get together") of amateur telescope enthusiasts will be held Saturday, August tenth, at Stellafane, near Springfield, Vermont. Postcard invitations will no doubt be sent to amateurs in nearby states, but it is emphasized that all are welcome. You need no invitation, and if you should happen by some omission not to receive one, *come anyway*. These gatherings are for the main purpose of



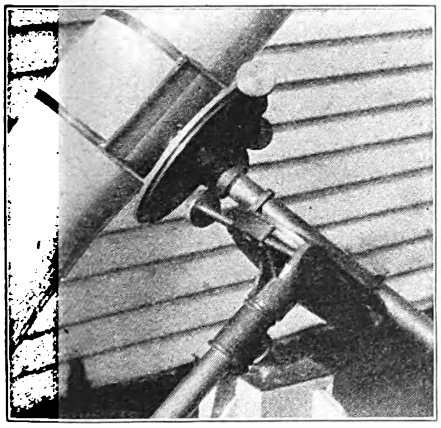
Mr. Ross's 12-inch reflector with adjustable polar axis. Weight of the instrument is 1000 pounds



Dr. Carlson's six-inch reflector

permitting amateurs to meet one another, trade ideas and experiences, and talk.

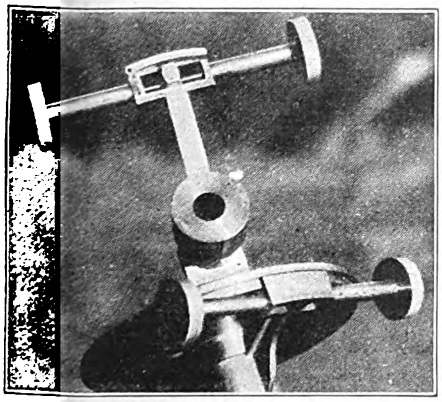
In last month's issue we spoke of the possibilities of making an amateur hobby of seismology. No returns have yet been received as this is written, because that issue of the magazine is not quite yet before the readers. However, there is still another hobby which a number of our readers have suggested for popularization—amateur microscopy. It would not pay to make one's own microscope (although this might prove interesting if the practical instructions were available) because the market is nowadays full of suitable microscopes at a cost of only about 20 dollars.



Details of axes and friction plates

Microscopy is a large subject, a "large order," too, for any editor who might rashly attempt to pose as an authority on it. Even one single aspect of it into which the present writer has slightly looked, that

(*Please turn to page* 182)



Slow motion and vernier

His answer was
"I Challenged an Axiom"

That is how Einstein explained it: How he knocked accepted mathematical limitations into a cocked hat—and laid down his theory of Relativity.

Fast's New Principle

Fast challenged an axiom when he made a flexible coupling without flexible materials. Heretofore "shut-downs for repairs" were probable as long as old-type couplings used flexible materials. By eliminating all flexible pins, bushings, springs, discs and grids, Fast's Coupling banished coupling failures forever.

Why Risk Shut-downs?

Every old-type coupling in your plant is a danger-spot. Eliminate flexible materials from your power drives, and shut-downs for replacements are permanently avoided.

Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

WHAT HAPPENS IN COUPLINGS
FATIGUE OF MATERIALS
What it is and how it occurs in flexible Couplings
H. F. MOORE

SEND FOR FREE BOOK
Prof. H. F. Moore, a leading authority on Fatigue of Materials, tells why eliminating flexible materials eliminates failure. Send the coupon today.

FAST'S
Self-Aligning
COUPLING

The coupling without flexible bushings, pins, springs, discs, grids or any other flexible materials.

THE BARTLETT HAYWARD COMPANY
204 Scott Street - - - BALTIMORE, MD.

Please send me the Free Book by Prof. Moore

Company____________________
Individual____________________
Address____________________
City____________________ State____________________

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Automotive

Facts and Figures of the Automobile Industry, 1929 Edition, presents up-to-date data pertaining to manufacture, exports, registrations, highways, bus lines, and other aspects of the automotive industry. *National Automobile Chamber of Commerce, 366 Madison Avenue, New York.—Gratis.*

Bus Facts for 1929 is a publication showing the amazing growth of the motor bus as a factor in transportation throughout the country. In addition to the other information presented, a list of bus companies is provided, with a map of the United States showing all major highways and those now served by established motor bus routes. *Motor Bus Division, American Automobile Association, Mills Building, Washington, D. C.—Gratis.*

Aviation

Notice to Aviators, published by the Hydrographic Office under the authority of the Secretary of the Navy, is a monthly publication furnishing information about landing and port facilities, sailing directions, et cetera, which will assist aviators in aerial navigation. It is primarily for the use of naval aircraft, but contains much timely information useful in commercial or private flying in regions adjacent to oceans, bays, lakes, rivers, or other navigable waters. The Department of Commerce maintains a central distributing point for all aviation charts published by the United States Army, Navy, and the Department of Commerce, at the *Coast and Geodetic Survey, 119 D. Street, N. E., Washington, D. C.* Airway bulletins and Aeronautics Bulletins may be obtained from the *Aeronautics Branch, Department of Commerce, Washington, D. C.*

Theory of Ballooning, prepared under the direction of the Chief of the Air Corps, Department of War, contains general directions, facts important in piloting a free balloon, and procedure to be followed in preparing a balloon, basket, and instruments for shipping. *United States Government Printing Office, Washington, D. C.—5 cents.*

Commerce

Merchant Marine Statistics for 1928, a contribution from the Bureau of Navigation of the Department of Commerce, is a 76 page compilation covering American tonnage, world tonnage, American waterborne commerce, and American seamen. *United States Government Printing office, Washington, D. C.—15 cents.*

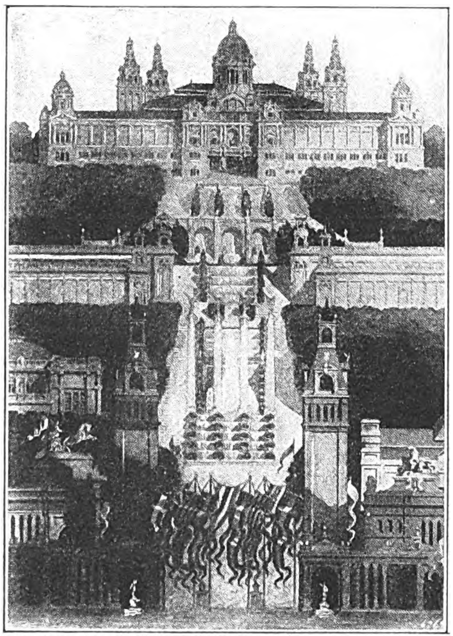
Transportation Charges in the United States and Canada contrasts the position of the Canadian railways with those in this country, particularly dealing with grain rates in the wheat-producing areas of the west. The case for the high rates on the privately-owned railroads of the United States is presented. *Association of Railway Executives, Transportation Building, Washington, D. C.—Gratis.*

The Upbuilding of Soviet Russia describes the industrial and commercial expansion in the Soviet states, with the intention of showing that the obstacles interfering with Soviet-American trade will have to give way before economic realities drawing the two countries into more complete intercourse. *Amtorg Trading Corporation, 165 Broadway, New York.—Gratis.*

Current Economic Data Pertaining to the Port of New York, Commerce Bulletin Number 1, briefly summarizes the activities of the world's greatest port. The bulletins, with up-to-date statistics, will appear monthly. *The Port of New York Authority, 75 West Street, New York City.—Gratis.*

International Trade in Petroleum and its Products is a booklet prepared by the Petroleum Section, Mineral Division, Department of Commerce, with the co-operation of the American Petroleum Institute. *United States Government Printing Office, Washington, D. C.—25 cents.*

Ibero America, a souvenir booklet issued to commemorate the Ibero-American Exposition in Seville and the International Exposition in Barcelona, might serve as a text-book in commercial geography. With well chosen illustrations and brief but intriguing sketches of the background and commercial standing of each country, the reader is carried from Spain and Portugal to Argentina, Bolivia, Brazil, Chile, and all of the other countries of the Americas, concluding with the United States, Uruguay, and Venzuela. Published in English and Spanish by the *International Telephone and Telegraph Corporation, 67 Broad Street, New York.—10 cents.*



Courtesy International Tel. and Tel. Corporation

Main entrance to the world-famous exposition at Barcelona, Spain. The Ibero-American Exposition is being held concurrently

British Chemical Trade in 1928, issued by the Department of Commerce as Trade Information Bulletin No. 621, shows the recovery of the British chemical industry from the trade depression of 1926, with considerable expansion and centralization which is expected to continue favorably during the present year. *United States Government Printing Office, Washington, D. C.—10 cents.*

Peanuts, a report of the United States Tariff Commission to the President, contains the proclamation of ex-President Coolidge raising the tariff to protect American peanut growers from competition with Chinese peanut growers. The report covers almost all phases of the peanut industry, with special attention to the differences in costs of production. *United States Government Printing Office, Washington, D. C.—15 cents.*

Communication

Radio, a booklet edited by Irwin Stewart, is an interesting volume in which a group of experts has attempted to portray in non-technical language a picture of the entire field of radio. Two chapters are devoted to the development of radio, three to the present status, two to federal legislation and administration, four to the various services performed by radio, and five to its place in international affairs. The booklet is well indexed. *American Academy of Political and Social Science, 3622 Locust Street, West Philadelphia, Pennsylvania.—Paper, one dollar; cloth, one dollar fifty cents.*

Airways Communication Service, by Edward B. Craft, is a discussion of the various communication requirements of aviation and of ways for meeting these needs. *Bell Telephone Laboratories, Inc., 463 West Street, New York.—Gratis.*

Investments

United States Lines, Inc., is a well-prepared review of the activities of this company, presented to prospective investors. The booklet is illustrated with photographs showing interior scenes on the S. S. *Leviathan, George Washington,* and other famous liners of the fleet. *P. W. Chapman and Company, Inc., 42 Cedar Street, New York—Gratis.*

CRUDE RUBBER is the title of a little booklet containing statistics on many phases of the rubber industry, including production, plantation areas, imports, consumption, and prices. It also has maps showing the important rubber-producing regions. *H. Hentz and Company, Hanover Square, New York.—Gratis.*

REPORT OF THE FEDERAL RESERVE BANK OF NEW YORK, for the year ended December 31, 1928, shows where our money goes and how we get it back, particularly in the realm of international finance. The much-discussed Federal Reserve policy is explained in brief. *Federal Reserve Bank of New York, 33 Liberty Street, New York City.—Gratis.*

WATER, THE INDISPENSABLE UTILITY gives a detailed description of a water company's plant and operations, with special reference to the investment values of securities of water companies. *G. L. Ohrstrom and Company, 44 Wall Street, New York.—Gratis.*

Miscellaneous

GREEK-ROMAN TREASURES OF GERMAN MUSEUMS is a beautifully illustrated introduction to the ancient works of art which are being preserved in the museums of Germany and Austria; a companion publication to appear soon will deal with the art of the Far East, as represented in the central European museums. *Terramare Office, Wilhelmstrasse 23, Berlin S. W. 48, Germany.—25 cents.*

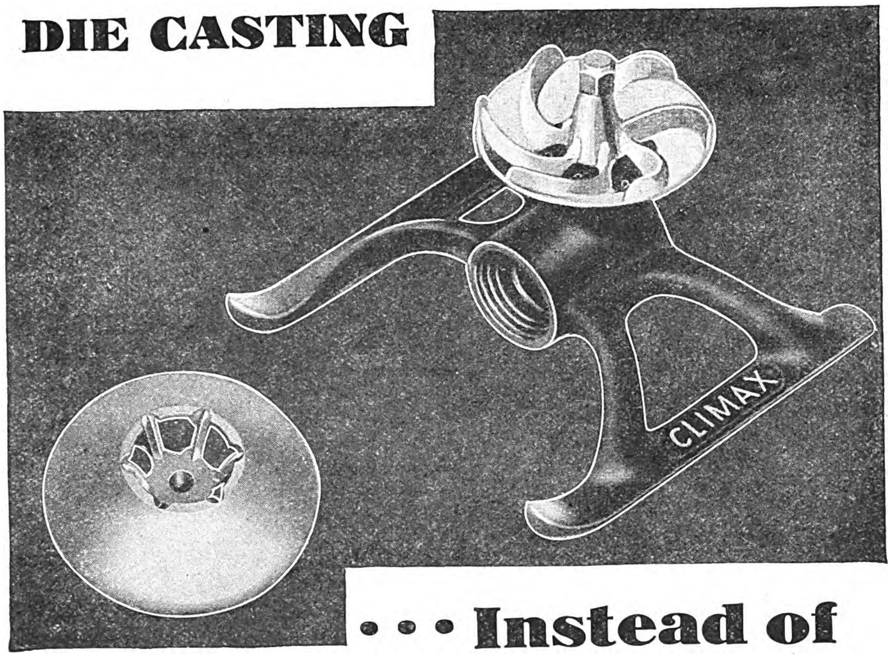
PARASITES AND THE AID THEY GIVE IN PROBLEMS OF TAXONOMY, GEOGRAPHICAL DISTRIBUTION, AND PALEOGEOGRAPHY, by Maynard M. Metcalf of Johns Hopkins University, treats the ever-interesting problem of parasites and their hosts from a broad viewpoint but with well-documented references and a good bibliography. *Smithsonian Institution, Washington, D. C.—Gratis.*

COST OF PROHIBITION AND YOUR INCOME TAX, one of the pamphlets issued by the organization seeking legal means of altering the present liquor situation, is a compilation of statistics intended to show from government figures that the "noble experiment" costs 936 million dollars a year. *Association Against the Prohibition Amendment, National Press Building, Washington, D. C.—Gratis.*

FAMOUS DIAMONDS, by Oliver C. Farrington, presents the essential facts and the interesting history of such great diamonds as the Cullinan, Dresden Green, Great Mogul, and the Kohinoor. The latter has been famous for centuries, and legends tell of its early history in southern India four or five thousand years ago; in 1526 it was appraised by an expert in diamonds as being worth "half the daily expense of the whole world." *Field Museum of Natural History, Chicago.—25 cents.*

SELF HELP FOR COLLEGE STUDENTS, issued by the Federal Bureau of Education, shows how one half of the men and one fourth of the women in colleges and universities of the United States are paying for their education by working during term-time. *Bureau of Education, Department of the Interior, Washington, D. C.—Gratis.*

ONE MILWAUKEE
DIE CASTING



. . . Instead of
3 different parts
smoother—no machining

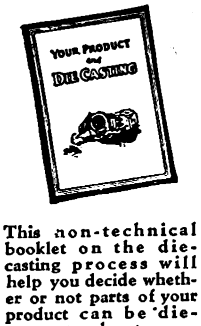
The top illustration shows the Climax Sprinkler, and presents a clear view of the top surface of the die-cast rotary.

The lower illustration presents the bottom view of the die-cast rotary alone.

THE Climax Lawn Sprinkler, made by the Hamilton Metal Products Co. of Hamilton, O., provides the theme for another story of improved design, better performance, fewer parts, simplified production and lower costs through the use of a Milwaukee Die Casting. By substituting an aluminum die cast rotary for a sand casting, the need for a brass bushing and copper washer was entirely eliminated. So was the machine and hand labor formerly required to put the three parts together.

The die cast rotary is delivered complete, ready for assembly. Its smooth, cone-shaped lower surface requires no buffing or polishing. Its light weight makes it much easier running than the type formerly used.

Die casting this part, and one other improvement, has enabled the manufacturers to increase production, reduce overhead and offer a lawn sprinkler that is extremely simple in design and operation.


YOUR PRODUCT and DIE CASTING

This non-technical booklet on the die-casting process will help you decide whether or not parts of your product can be die-cast to advantage.

Why not find out whether or not die casting can improve your product or simplify your production problems. Your inquiry does not obligate you in any way.

MILWAUKEE DIE CASTING COMPANY
287 FOURTH STREET MILWAUKEE, WIS.

MILWAUKEE
DIE CASTINGS AND BEARINGS

WHY WASTE TIME FIGURING?

Here's a Mechanical Pencil *that* Multiplies *and* Divides....

THINK of it! A pencil that actually does your mathematical thinking for you. Multiplies, divides, works percentages and proportions—solves scores of difficult problems *without touching pencil to paper.* Simply set the slides and read the answer—easy to read as a clock.

Invaluable for quickly calculating stock yields; computing foreign exchange, measuring areas and volume; estimating production and sales costs; taking inventories; figuring "mark-ups," "mark-downs," discounts, etc., and for solving a host of other problems.

The Multi-Vider, as it is called, has all the features of a high-grade mechanical pencil—*plus* the remarkable device for making rapid-fire calculations. Smart-looking; comfortable size—no writer's cramp; outside metal parts gold filled or silver-filled as desired; takes any standard thin lead; propels, repels, expels; mechanically perfect—yet costs no more than any other fine mechanical pencil. Also makes a wonderful gift.

If your dealer cannot supply you, mail coupon. On arrival of Multi-Vider pay postman only $5 (or $10 if you prefer the gold-filled Executive model in handsome gift box.) After 5 days, if not delighted, simply return it. Money promptly refunded.

RUXTON
MULTI-VIDER
multiplies - divides

Ruxton Multi-Vider Corporation,
4067 Graybar Bldg., New York City.

Please send me a Multi-Vider with instructions for use. On arrival I will pay the postman price quoted below plus a few cents postage. Within 5 days, if not satisfied, I may return the Multi-Vider and you are to refund my money. I am checking the model I want: (—) Standard Model, $5. (—) Gold-filled Executive model in handsome gift box, $10.

Name...

Address...

City..............................State..........................

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
STEEL LETTERS AND FIGURES
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

USE THIS COUPON

BUILD A HOME on YOUR LOT
PAY for IT LIKE RENT

If you are handy with tools you can save $500 to $2,000. Materials shipped Ready-Cut direct from our factories.

Sears, Roebuck and Co., Chicago or Philadelphia
Send Free Book. *Scientific American, 8-29*

Name..

Address......................................

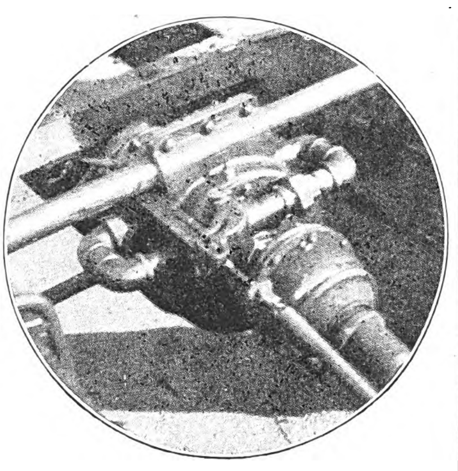
The Scientific American Digest

(*Continued from page* 163)

then hooked up enough motive power to handle it, it would require a million engines and a similar number of caboose cars to furnish housing for the train crews necessary to handle the train, and incidentally it would take a crew three times as large as the entire population of Chicago to run it. Using a conservative length for each unit of this composite train, we would have 10,000 miles of locomotives, 390,732 miles of train and 5685 miles of caboose cars, an over-all length of 406,417 miles. Routed west through Chicago and reported on block 7:00 A.M. this morning, traveling 30 miles per hour, it would require approximately 564 days and 11 hours to clear the block, having wrapped itself around the world more than 16 times enroute. This train represents the growth of freight transportation in 100 years, and yet some people claim the romance has gone out of railroading."

True Hydraulic Automobile Brake

IN a hydraulic brake manufactured by F. L. Barris of San Francisco, the braking effect is produced within the brake itself and not transferred to brake bands. The brake is in the form of a rotary pump which is keyed to the drive shaft back of the transmission and which, when the brake is on, pumps oil through a very short closed circuit in which is located the control valve. The braking pressure is established by closing down this control valve so as to place an excessive back pressure on the oil pump.



The true hydraulic brake mounted in the chassis of an automobile

The blades of the pump are withdrawn and held within the inner rotor when the brake is in the off position, thus producing no pumping action, circulation of oil, or pressure of any kind. When the brake is required for service the blades are instantly released and the braking pressure established at once.

The control is by means of the usual foot pedal, more or less braking effect being produced as the foot pedal is moved forward or back. The braking effect is the same, forward or backward. No pressure is carried when the brake is in the "off" position and since the brake bands, with their attendant rods and connections, are eliminated, it follows that there are no brakes to be relined or adjusted.

The braking effect does not change from time to time, as when brake shoes and

Service

BUSINESS today is based upon service. The grab and run manufacturer is almost extinct. Advertising has played its part in his passing. By contrast with the open methods of others, it has thrown his operations into such sharp relief that it has left him no recourse. His failure was inevitable.

People have come to depend upon consistently advertised merchandise. They have confidence in the manufacturer who places himself on record month after month as to the merits of his product. They know he will maintain that product at the standard he has set, not only for their protection but for his own. Should he drop below, the buying public would soon discover it, and his business would be faced by ruin. No manufacturer who is spending large sums to produce, advertise and sell an article is going to take that risk.

Quality, utility and value are the things uppermost in the mind of the advertiser today. Improving his product, making it more useful to you, giving you greater value for your money, these are his aims. When he succeeds, he tells you about it—in the advertisements.

If you neglect the advertisements, you are missing one of the most vital features in this magazine.

brake lining are used, but remains the same at all times, as there is nothing to wear out and no adjustments to be made. The brake is self-oiling and therefore requires almost no attention.

In addition to the automobile, this system adapts itself to many other machines where brakes are required.

Ant "Cowboys" Faithful to Their Insect Cattle

THAT ants, like humans, have cattle, is an old story, but the faithfulness with which they attend their little green "cows" has had a new light shed on it by the researches of Dr. Herman Eidmann, of the University of Munich. Charge over a given herd of aphids is not turned over to any chance ant out of a nest, but to certain designated individuals, and these return day after day to the same twig where their particular aphids are feeding. There they watch over them, drive off or kill strange ants, and protect their herds from other natural enemies.

Dr. Eidmann learned that the same ant returns to the same twig full of aphids regularly by the simple trick of putting dabs of colored paint on the ant herdsmen, and corresponding paint spots on the twigs where he first saw them. After that he found the colors on ants and twigs matching without fail every day. So faithful were the six-legged cowboys that when the weather became warm enough they frequently remained on the twigs all night instead of returning to the nest. And although the species under observation is one that ordinarily avoids the light, the members of the colony that had the job of aphid-herding assigned to them would patrol their twigs in the full glare of the midday summer sun.—*Science Service.*

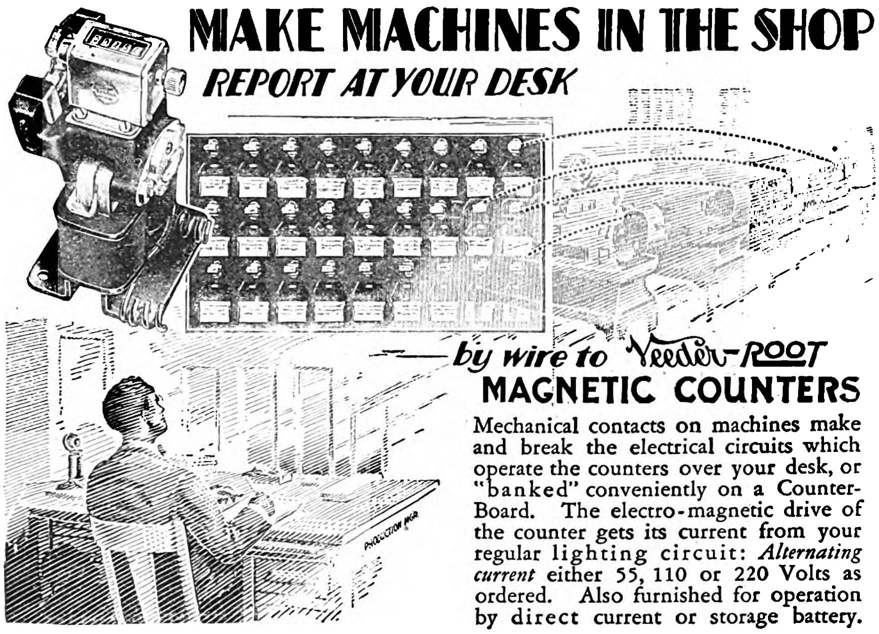
Tunnel Yields Its Cost in Gold

GOLD struck in tunneling an aqueduct for Manila more than equals the cost of the undertaking. The 9000-foot vein was recently estimated to contain 20,000,000 dollars worth of ore. No particular surprise was occasioned, for within a thirty-mile radius of the Philippine capital at least two gold lodes and several areas of placer ground had already been located.

Since Spain ceded the islands to the United States in consideration of Dewey's victory and 20,000,000 dollars cash, the Philippines have yielded in gold alone 23,767,000 dollars. Silver is usually found alloyed with the gold, and the annual output of minerals now is nearly 5,000,000 dollars in value.—*New York Times.*

A 50,000,000 Dollar Pest

IT costs in the neighborhood of 50,000,000 dollars a year for cattle owners, dairymen, feeders, butchers, and tanners to support the cattle grub, yet this pest can be destroyed. Either the old method of hand extraction may be used, or the newer methods developed by the United States Department of Agriculture. The department advises the application of Derris as a wash, ointment, or powder, pyrethrum ointment, fine tobacco powder or nicotine dust, or the injection of benzol or carbon tetrachloride. A concentrated drive on the cattle grub is necessary to eradicate it from a locality. The pest is becoming more serious, says the department, owing to the spread of a second species of grub, known as the northern, or European, grub.


MAKE MACHINES IN THE SHOP
REPORT AT YOUR DESK

by wire to Veeder-Root
MAGNETIC COUNTERS

Mechanical contacts on machines make and break the electrical circuits which operate the counters over your desk, or "banked" conveniently on a Counter-Board. The electro-magnetic drive of the counter gets its current from your regular lighting circuit: *Alternating current* either 55, 110 or 220 Volts as ordered. Also furnished for operation by direct current or storage battery.

Bring machines—*in effect*—right into your office to tell you what they've PRODUCED. Watch their performance from where you sit, as registered on Veeder-Root Magnetic Counters. See which machines—at any minute—are running, or idle, or producing too little. Get the records *by wire* from any remote point. Continuous check-up on machine operators.

Ask us about the application of this latest and greatest advance in Production-Control.

Veeder-Root INCORPORATED HARTFORD, CONN.

Offices in the Principal Cities; write or phone.

MONEY **MYSTERY GAS LIGHTER** MONEY
JUST OUT. LIGHTS GAS INSTANTLY WITHOUT SPARKS OR FLAME · SELLS LIKE WILDFIRE WHEREVER GAS IS USED —RETAILS FOR 25¢
MAKE $25. A DAY
· SAMPLE FREE ·
PACKED ON INDIVIDUAL CARDS WITH INSTRUCTIONS
RUSH $10.00 FOR GROSS or 1.00 FOR DOZ.
NEW METHOD MFG. CO.
Desk SA-8 Bradford, Pa.

WANTED PRODUCTION MAN
Thoroughly trained and educated man competent to take charge of highly technical small work. Must have management experience. J. H. W., Box 190—Scientific American.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

20 Colors

UNIQUE
TRADE MARK REGD
THIN LEAD
COLORED PENCIL

Makes fine lines in color 10¢ each
for
Checking, Underscoring,
Map Coloring, Sketching,
Marking Blueprints, etc.

Essential in every
Office, Drafting Room,
Studio, School and Home

Blue, Red, Green, Yellow, Purple, Brown, Black, Orange, White, Lt. Blue, Pink, Lt. Green, Maroon, Sepia, Mauve, Dark Red, Olive Green, Chr. Yellow, Violet, Vermilion

12 Colors (Asst. No. 1116) Per Box $1.00
24 Pencils (Asst. No. 1117) Per Box $2.00

At all dealers or write direct
AMERICAN PENCIL CO., 542 Venus Bldg., Hoboken, N. J.
A Venus Pencil Factory Product

AMATEUR TELESCOPE MAKING

can be made a contribution to science, as well as a hobby, with a possibility of definite attainments, by following the practical instructions of the book by that name.

$3.00 postpaid domestic

SCIENTIFIC AMERICAN

Electricity!
Learn in Los Angeles

Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00 — unlimited opportunities now.

Practical, intensive training by National's job-experience method in 6 to 9 months. All technical essentials included. School endorsed by leaders in electrical industry. You learn all branches of electricity; radio. Million dollar institution; all modern equipment and training facilities. Life scholarship. No age limit. Free employment service. Over 17,000 successful graduates. 23rd year. Big, illustrated 84-page catalog sent FREE. Write today.

FREE BOOK

NATIONAL ELECTRICAL SCHOOL
Dept. 300-EC 4006 So. Figueroa, Los Angeles, Calif.

The Amateur Astronomer

(Continued from page 177)

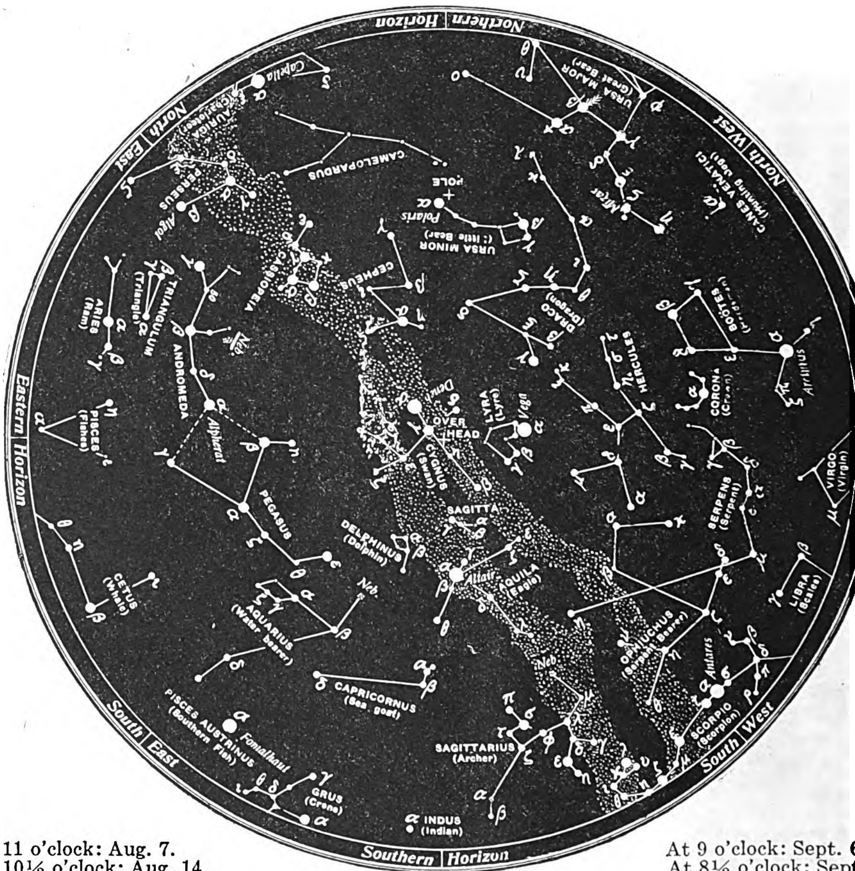
is, the study of the microscopic living forms of life in pond water, ditches and streams, is too broad a subject for any but a whole-time specialist to encompass. However, this one phase of microscopy affords a most fascinating field for the scientifically inclined amateur.

Few people realize the immense number of interesting live forms of microscopic life to be found in half a drop of pond water. One can remain for hours watching the antics of an amoeba, or the beautiful rotational motion (which is really an optical illusion) of a rotifer. One other form, less animated, the diatom, is the subject of an article in the present issue, and the reader's attention is called to the footnote placed beneath that article (page 113). These and hundreds, yes thousands, of other forms are widespread in their distribution; in fact they vary little throughout the world, because they are so easily transported by natural agencies. You will find them in the average ditch; in the river, creek, and brook; in the old swimmin' hole; and doubtless in the tap water in your kitchen.

A microscope which magnifies more than 100 diameters will suffice very nicely to render them visible, and a few old bottles and inexpensive gadgets complete the outfit. How many readers are sufficiently interested in this outdoor hobby for the amateur scientist to write in and say so?—*A. G. I. Tel. Ed.*

The Heavens in August

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North West
Western Horizon
South West
Southern Horizon
South East
Eastern Horizon
North East
URSA MAJOR (Great Bear)
CANES VENATICI (Hunting Dogs)
Mizar
POLE
Polaris
URSA MINOR (Little Bear)
CAMELOPARDUS
Capella
AURIGA (Charioteer)
PERSEUS
Algol
CASSIOPEIA
CEPHEUS
DRACO (Dragon)
BOÖTES
Arcturus
CORONA (Crown)
HERCULES
LYRA (Lyre)
Vega
Deneb
OVER HEAD
CYGNUS (Swan)
SAGITTA
Altair
AQUILA (Eagle)
DELPHINUS (Dolphin)
SERPENS (Serpent)
VIRGO (Virgin)
LIBRA (Scales)
OPHIUCHUS (Serpent Bearer)
Antares
SCORPIO (Scorpion)
SAGITTARIUS (Archer)
Neb
INDUS (Indian)
GRUS (Crane)
PISCES AUSTRINUS (Southern Fish)
Fomalhaut
CAPRICORNUS (Sea goat)
AQUARIUS (Water bearer)
PEGASUS
Alpherat
ANDROMEDA
Neb
TRIANGULUM (Triangle)
ARIES (Ram)
PISCES (Fishes)
CETUS (Whale)

At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

MERCURY is an evening star, too near the sun to be seen at first and low in the twilight, even at the month's end when he sets about 7:30 P.M. (by Standard, not by Daylight Saving, time). Venus is a morning star, rising at 2 A.M. in the middle of the month, and is very conspicuous. Mars is an evening star in Leo and Virgo, setting about 8 P.M. Jupiter rises at 12:45 A.M. on the 1st and 11 P.M. on the 31st. He is in Taurus, and next to Venus is the brightest thing in the morning sky. Saturn is in Ophiuchus and is the only planet which is well visible in the evening. He comes to the meridian about 10 P.M. in the middle of the month and is at his brightest, since his rings are seen at the most favorable angle. Uranus is in Pisces, observable in the morning hours; and Neptune is in conjunction with the sun on the 24th and is invisible.

The moon is new at 11 P.M. on the 4th, in her first quarter at 1 A.M. on the 12th, full at 5 A.M. on the 20th, and in her last quarter at 3 P.M. on the 27th. She is nearest the earth on the 3rd, remotest on the 16th and nearest again on the 31st. As she sweeps round the sky she passes near Jupiter on the 1st, Venus on the 2nd, Mercury on the 5th, Neptune on the 6th, Mars on the 7th, Saturn on the 10th, Uranus on the 23rd, and Jupiter again on the 28th, thus rounding out her cycle.

BUSINESS OPPORTUNITY

For the First Time!

Drug store scales, those familiar scales that you see everywhere, that give your weight for a penny, are proven money makers. Now comes a new and better scale of unusually striking appearance that prints the weight and fortune on a ticket. And for the first time, individuals have the opportunity to own and operate chains of these scales. If you have some money and are willing to back it with a small amount of your time, the ownership of a chain of these new scales will show you, we feel confident, the kind of earnings which will interest you. It will cost nothing to find out more about it. You are invited to write for a booklet in which we have set down in detail our full proposition to prospective scale operators. Write Dept. 118, International Scale, 17 East 45th St., New York, N. Y.

Why PURE CHEMICALS CORRECT ALL FEED WATER TROUBLE!

They prevent precipitation, control concentration, stop and prevent corrosion and pitting, remove oil or grease (carbonized or not), act uniformly under all temperatures and pressures, everything that is required to successfully treat boiler feed water. Only Pure *Corrective Chemicals* do this. *Pamphlet on Request*

UNISOL MANUFACTURING CO.
Jersey City, N. J., U. S. A.

Orders for UNISOL may also be purchased through HENRY W. PEABODY & CO., Export & Import Merchants, 17 State Street, New York City, N. Y., and their branch offices in Boston, San Francisco, London, Liverpool, Manila, Shanghai, Sydney, Melbourne, Auckland, Cape Town, Johannesburg, Durban, Buenos Aires.

Sime, Darby & Co., Limited, Singapore, S. S. Agents for Straits Settlements

CRESCENT -TOOL- COMPANY

Inventors--We Build Models

Send us your rough idea. Our Master Mechanics will develop it for you into a practical working Model. Thirty years successful experience doing this very thing. Best shop equipment. Expert advice. Confidential service guaranteed. Bank reference furnished. Send for free booklet "The Road To Success."

CRESCENT TOOL CO., Dept. C. Cincinnati, Ohio

Be An Auto Expert!

LEARN IN LOS ANGELES

TRAINED MEN NEEDED. Earn $40 and up a week. If you are earning less this is your chance to gain, Auto industry will pay you more and offer greater opportunity. You qualify for Big-Pay Job through National's Famous Job-Experience Training. Over 17,000 Successful Graduates. California is Land of Opportunity. Millions being spent on autos here. Learn Mechanics, Ignition, Repairs, Construction, Garage Management, Etc. Qualify for technical or executive position or go into business for yourself. ENTER NOW. No Age Limit. Low Tuition. 23rd Year. Unexcelled Training. Thirty-two instructors . . . Free employment service while learning and after graduation. Write for Illustrated Catalog . . . FREE . . . Tells everything.

No Free R. R. Fare
An Honest School
Honestly Priced
Accredited by the Automobile Industry Everywhere

NATIONAL AUTOMOTIVE SCHOOL

Dept. 300-AC. 4006 Figueroa St., Los Angeles, Calif.

Send me the big, FREE National Auto Book that explains how I can Succeed in the Automobile Industry.

Name ------------------------------------
Address ------------------------------------
City -------------------- State -------------------- Age ----

Chemistry in Industry

(*Continued from page 174*)

alkali and some soap, says Arth R. Maas in his jolly little house organ, *Chemistry and Us*.

The alkali cuts the grease. The soapsuds thin it into a "soup" called "dishwater." Some of this "soup" is left on the dishes, as a film.

That's what drives customers away.

When the chemist washes dishes, he wants at least three big pans.

In the first, he puts hot water and a cleaning compound with a tri-sodium-phosphate base. This cleaning compound takes up the grease in colloidal suspension, instead of thinning and spreading it around.

A second pan of hot water, with a weaker solution of the compound, makes the dishes quite clean. A third pan of hot water alone rinses them so they dry bright, without wiping.

Peroxide Also Bleaches Cereals

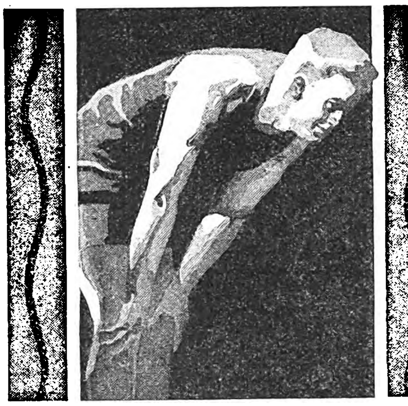
ONE of the most striking examples of the penetration of refined chemical methods into all branches of industry is the introduction and extensive use of peroxides in the cereal industries. Benzoyl peroxide, some years ago known only to a small number of chemists and familiar to hardly any one of them, is now widely used by millers, not only in the United States but in all countries of the world.

G. Van der Lee, writing in a recent issue of *Food Industries*, describes the bleaching of flour as an oxidation process and explains why the action of oxygen in the atmosphere does not perform the bleaching action as well. The answer is that flour is indeed bleached to a small extent by exposure to the air. This natural bleaching, also called aging or maturing of flour, has been known to millers for a long time. However, as the oxygen in the air is in an inactive state, a much less intensive bleaching was obtained, even after prolonged contact. For this reason the fact that chemistry has developed a method to intensify the oxidizing power of the atmospheric oxygen by converting it into a solid compound, from which it is easily released in an active form, may be considered as a long step forward. The uncontrollable and time-consuming aging and maturing of flour by nature thus has been superseded by a safe, rapid, and far more effective process based on scientific principles.

New Oil for Old

WE have often wondered how the lamp peddler of Arabian Nights fame made a living with his policy of "new lamps for old." Perhaps he was simply the forerunner of the trade-in plan, since popularized by automobile dealers, but we prefer somehow to accept the more colorful explanation that he possessed some magic secret that enabled him to rejuvenate battered old lamps by a mysterious incantation. Such a theory is hardly more fantastic than the former, prosaic one, in the light of an apparatus recently introduced to make new lubricating oil out of old. Looking for all the world like an overgrown electric refrigerator, this modern magician is fed dirty, dilute, crank-case oil, and without more than occasional supervision by human beings, steadily delivers a

For safety in Exercise *wear a PAL*



Pal ATHLETIC SUPPORTER

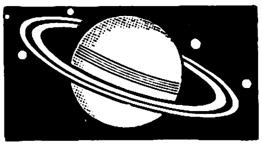
© B. & B., 1929.

A faulty dive . . . an awkward kick when swimming . . . and suddenly, pain . . . the paralyzing pain of a wrenched cord . . . in the water, that's a dangerous situation, unless help is near.

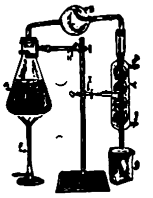
• • •

PAL is far superior to the ordinary all-elastic supporter. It is porous . . . knit of soft-covered elastic threads. A more *efficient* supporter . . . snug where it should be . . . comfortable all over. PAL doesn't get perspiration-stiff . . . doesn't chafe. At all drug stores . . . one dollar. *(Price slightly higher in Canada.)*

Bauer & Black
A Division of the Kendall Co.
CHICAGO . . . NEW YORK . . . TORONTO
Also makers of the famous O-P-C
For 40 years the leading suspensory for daily wear



ASTRONOMICAL
TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.



CHEMISTS

Catalog listing 2500 illustrations chemists supplies, 5000 chemicals, 1000 scientific books sent for 50c.

LABORATORY MATERIALS COMPANY
637 East 71st Street Chicago

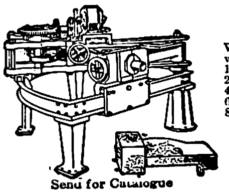
"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe

Standard of the World
Hand and Motor Operated
14 Sizes of Machines

What it costs to bend pipe our way, per bend:

1-inch pipe	5 cts
2-inch pipe	10 cts
4-inch pipe	25 cts
6-inch pipe	60 cts
8-inch pipe	$1.00

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.



Send for Catalogue

Home-Study Business Training

Your opportunity will never be bigger than your preparation. Prepare now and reap the rewards of early success. Free 64-Page Books Tell How. Write NOW for book you want, or mail coupon with your name, present position and address in margin today.

☐ Higher Accountancy
☐ Modern Salesmanship
☐ Traffic Management
☐ Railway Station Management
☐ Law: Degree of LL.B.
☐ Commercial Law
☐ Industrial Management
☐ Banking and Finance
☐ Telegraphy
☐ Business Management
☐ Business Correspondence
☐ Credit and Collection Correspondence
☐ Modern Foremanship
☐ Personnel Management
☐ Expert Bookkeeping
☐ C. P. A. Coaching
☐ Business English
☐ Commercial Spanish
☐ Effective Speaking
☐ Stenotypy—Stenography

LaSalle Extension University, Dept.851-R, Chicago

"14 WORDS OF MAGIC POWER" FREE

—that is what the multi-millionaire gave to the young man who saved his life. 14 WORDS that created the rich man's millions. The young man *used* them. They made *him* worth a *quarter of a million dollars in 5 years.* Do you want to know what these words were—and how you can use them? A fascinating little book tells the story. It is yours free IF you are a young man 16 to 32 years of age and willing to consider using a part of your spare time preparing for a worth-while position in the big pay fields of Drafting, Engineering, Electricity or Architecture through any one of these three plans:

1. 1, 2 or 3 yr. training at Chicago Tech. Diplomas and B. S. Degrees. Opportunities for self-support. Day and Evening classes—or
2. A short 4 months' special course in Drafting. Quick preparation. We help you secure position when through training—or
3. Train at Home in Drafting. Keep your present job and prepare for a better one in spare time. All tools supplied without extra cost.

This Free Book is yours—if you write for it and indicate the plan (by number) that interests you.

ADDRESS: DEPT. K-57, CHICAGO TECHNICAL COLLEGE, 118 East 26th St., Chicago, Ill.

PRATT INSTITUTE
BROOKLYN, N. Y.
SCHOOL OF SCIENCE AND TECHNOLOGY

Industrial Mechanical Engineering
Industrial Electrical Engineering
Industrial Chemical Engineering

Intensive TWO-YEAR Courses
Send for Circular of Information

Bond Stock Gears

Stocked in convenient centers throughout the United States, Bond Stock Gears offer an immediate delivery feature that is a decided time-saver when breakdowns occur.
Send for Gear Catalog No.54-S.

CHARLES Bond COMPANY
617 Arch Street, Philadelphia, Pa.

GEARS
All Kinds—Small

The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

The famous Matthews "38" Stock Cruiser
Speeds 15 to 30 miles
Go anywhere in a Matthews Cruiser

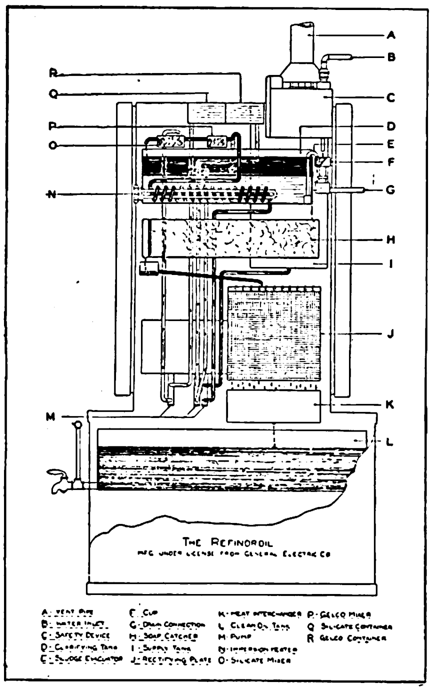
"38" Matthews

ENJOY THE PLEASURES OF CRUISING
Matthews "38" Single Cabin, Double Cabin, Sport Cruiser, Day Cruiser
Matthews "34" Speed Cruiser
Matthews "46" Double Cabin, Single Cabin, Sport Cruiser
Ask for Folder L
THE MATTHEWS CO., Port Clinton, Ohio, U. S. A.
Quality Service Since 1890

clean oil ready to go back into a crank case for its second useful life.

The principle of this oil reclaimer was explained by SCIENTIFIC AMERICAN four years ago, when it was first developed by the General Electric Company. It is a far cry, however, from the first crude application of the principle to the modern, foolproof, and automatic installation now being marketed by the Refinoroil Company, of Elmira, New York. Briefly, its operation is based on the fact that lubricating oil does not "wear out" in service, but simply undergoes certain changes, rectification of which, together with the removal of accumulated dirt and carbon, leaves it as good as new.

The most important underlying principle of the process is the remarkable effect which silicate of soda (water glass) has been found to have. Chemically, this substance functions as an alkali, and as such its action is probably not different from that of any other alkali. It is the physicochemical character of the sludge produced in the oil by shaking with the concentrated solution of the silicate that sets it apart from any other material, and that alone has made practical the development of an automatic, continuous machine.



Oil reclaiming apparatus using "water glass" and an inexpensive chemical called "Gelco" for clarification and rectification of used lubricating oil. The rectified oil is redeemed at a total cost of about ten cents a gallon. Reclaimed oil is said to be "as good as new"

Reclamation by this system is effected in two steps: clarification and rectification. The oil is first treated hot with a small quantity of an inexpensive chemical called "Gelco," followed by the addition of an equally small amount of concentrated silicate of soda solution. In this way a sludge is formed which carries all solid and other impurities, even when present in microscopic or colloidal form. This sludge settles quickly, sinking into an underlying body of water which is constantly being pumped out and replaced by fresh water. The diluents are next removed by passing the clarified oil in a thin film over electrically heated plates in a lively current of

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
BERNARD & HELLER LABORATORIES
Labor Saving Machinery Designed & Built
Circular – References – Guarantee – Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

I SELL PATENTS

If you wish to add New Products to your line, or have a good Patent to sell, write me—

CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

Auto Specialty Salesmen
Unlimited possibilities with DECARBONOL Lubricator.
Write G. F. R., MFG. CHEM. ENG.,
1830 North Park Ave., Chicago, Ill.

ELECTRICAL PROBLEMS?
THE A. H. S. ELEC. SERV. & ENG. BUREAU, SPECIALIZING
In Personal Service, will solve them for you with Precision.
P. O. No. 132. FLUSHING, NEW YORK

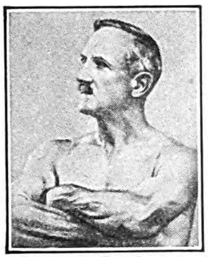
S
AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

BECOME A FOOT CORRECTIONIST

$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.

STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

ASBESTOS
All grades of Crudes and Fibres in large or small quantities
Sold by
KEASBEY & MATTISON COMPANY
Ambler, - Penna.
Branches in Principal Cities



Strengthen Your NERVES

The stronger your nerves are, the stronger you are in muscular power, vitality and brain power. Nervousness wrecks your Health and Happiness. It is the direct cause of nervous indigestion and endless other ailments and weaknesses. If you have weakened your nerves through worry, mental strains or perhaps neglected them through ignorance, you can strengthen them 100 per cent in a short time by applying the advice contained in my 64-page illustrated book on the CARE OF THE NERVES. The cost is only 25 cents (coin or stamps). This book will open to you a new path to a higher and happier life and health. It teaches how to control and calm the nerves, and how to make yourself immune to nerve strain.

Paul von Boeckmann at the age of 57 years—the acme of Strength, Health and Nerve Force.

Paul von Boeckmann is a national authority on NERVE CULTURE, deep breathing, psychology and kindred subjects. Over a million copies of his various books have been sold, and they are on file in many libraries and at the National Medical Library.

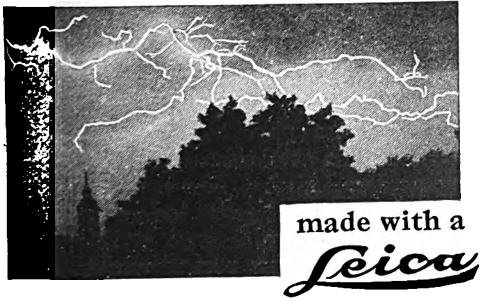
Thousands of Letters like these:

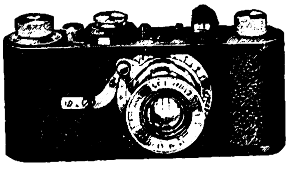
A physician writes as follows: "I am writing you as a Graduate M.D. to say that I have carefully read your excellent book on 'Nerves.' It has done me more good already than anything I have seen or tried and I think it easily worth a hundred times what I paid for it. It is impossible to read it without *feeling* the wonderful *Truths* it reveals."

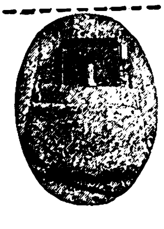
A school teacher writes: "I had the opportunity of reading Paul von Boeckmann's 64 page book 'Nerve Force.' I completed it in one reading. One feels at home and understands unfathomed ideas concerning nerves, mind, and body. As I was reading it a stranger approached and remarked, 'That book cured me of what doctors called stomach trouble. I had nothing of the kind, it was just nervousness. I am now a well man.'"

TODAY—NOW. Order the book. It will be worth its weight in gold to you.

Write Paul von Boeckmann
Studio 1811 48 W. 48th St., N. Y. City







A remarkable picture taken with a remarkable Camera, the Leica. Accompanies the Byrd Expedition and is the enthusiastic companion of explorers, scientists, and all who value perfection.

THE smallest roll film camera with focal plane shutter. The first camera using cinema film to give negatives of double frame size. Thirty-six pictures on a single load. Enlargements to 12" x 18" or more without loss of clearness. Mechanically and optically a perfect instrument, unaffected by climatic conditions. Equipped with a Leitz Anastigmat F 3.5; shutter speeds 1/20 to 1/500 sec. See the Leica at your dealer or write for illustrated literature.

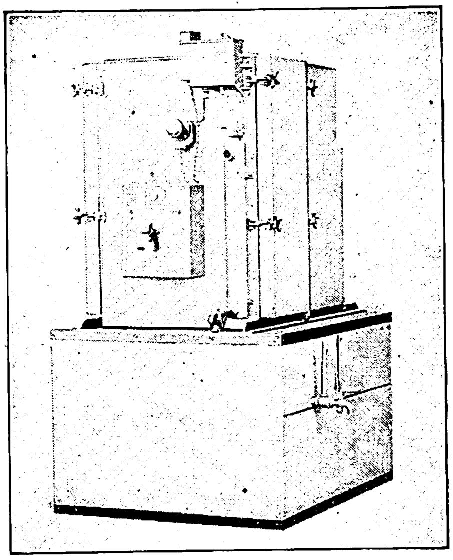
E. LEITZ, Inc., 60 East 10th St., New York, N.Y.

E. LEITZ, Inc.,
60 East 10th Street, N. Y.

You may send Pamphlet 1127 S. A. 4 on the LEICA Camera.

Name..

Address..

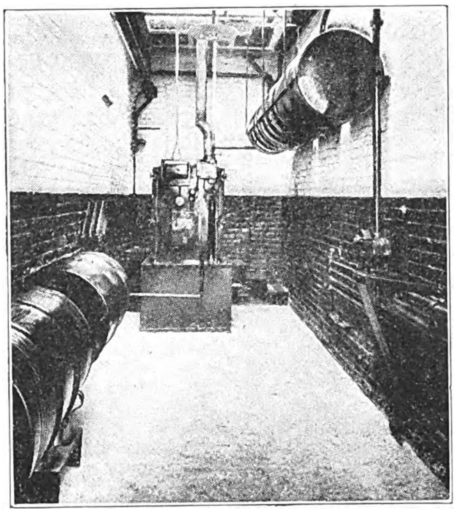


Exterior view of the electrically-operated machine used for removing impurities from used lubricants

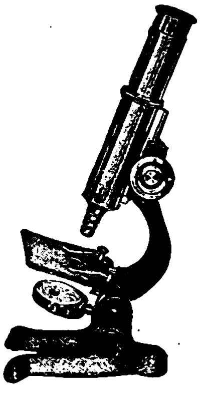
air. This method was adopted, inasmuch as rectification of diluted oil, by heating in bulk, requires temperatures well in excess of the figure at which rapid oxidation of the oil begins.

The machine, which is shown in the accompaning illustrations, is designed for 24-hour operation without attention, and all containers are built large enough to accommodate the various liquids for even longer. The apparatus is self-contained, so that no separate tanks are required. The supply tank in the machine is filled with dirty oil once a day. At the same time the chemical containers Q and R are filled with silicate and "Gelco" respectively. No measuring is required, the containers simply being filled to the top. A few moving parts in the machine are operated by a one tenth horsepower motor.

At three cents per killowatt-hour current rate, the total operating cost, including power and chemicals, is estimated at 10 cents per gallon of reclaimed oil for either the 8-, 20-, or 50-gallon (per day) machine. The savings per year, at a cost of 50 cents per gallon for new oil, are 1022 dollars for an eight-gallon reclaimer, 2555 dollars for a 20-gallon machine, and 6387 dollars for one of 50-gallon daily capacity.



Installation showing an oil-reclaiming machine, with auxiliary storage tanks, located at a large motor bus terminal in Boston



250-POWER MICROSCOPE

COMPLETE $16.50

The greatest value ever offered in a microscope—same type as used by Scientists, Physicians and Professional Physicists—a 250-power instrument with standard focusing arrangement. Ocular or lens at top of tube is double, removable and of high quality. Removable feature permits use of other standard ocular systems, giving many power ranges. Objectives mounted at bottom of tube, are of substantial triple construction and powers are approximately 65, 130 and 250. Laboratory type stand is fully adjustable so that instrument can be used for photographic work. Stage is extra large; equipped with clips for holding slides and objects. Just below stage is adjustable iris diaphragm so that light from mirror can be adjusted by touch of finger. Mirror is double, plain on one side and concave on reverse. Complete in handsome wooden case at the amazingly low price of $16.50. Save money . . . buy direct—money refunded if not absolutely satisfied after 5 day trial. Send check, money order or cash. Other equally amazing microscope values at prices up to $220 described in interesting folder—"Exploring Invisible Worlds." Write for your copy.

APPARATUS ENGINEERING CO.
Dept. A, 2006 Chestnut St.
Philadelphia, Pa.

ASTRONOMERS

with suitable telescopes are requested to search in the neighborhood of R.A. 15h. 9m. S. Dec. 17° 38′ (Helio Long. 229° Lat. ± 2°), where an extra-Neptunian planet will be found.

DOES SCIENCE AFFECT YOUR BUSINESS?

SCIENCE NEWS-LETTER

This is the weekly summary of current science published by Science Service. It brings to you in simple fascinating style quick, accurate stories of science. It *covers every scientific branch* with a staff of trained writers who are also trained scientists. It is a publication that is unique, rich in content, and enjoyable from cover to cover. Science News-Letter will give you many a pleasant hour of reading.

DOES YOUR CONVERSATION GROW TRITE?

Introductory offer
—$2 for 6 months

2155 B St., N. W.
Washington, D. C.

Our Choice of Recent Books

Physics for College Students

By A. A. Knowlton, Ph.D.

WE enthusiastically recommend this new book. One of our editors started merely to sample it, but he ended up by reading it from cover to cover because its contents were presented in so unusual, so bright, and so lucid a manner that he found himself actually enjoying its study night by night. The book is not like any physics heretofore written. The author has discarded the old, conventional, stereotyped arrangement and adopted a new one designed to maintain interest in the subject. The language and treatment are much more full than usual (the book has 641 pages) and the author seems especially to have sensed just which erroneous preconceptions or half correct ideas usually perplex a beginner, and has anticipated the answers in naive terms, instead of partly "holding out on" the reader, as has too often happened elsewhere. It is of course impossible to make physics "dead easy" except by entirely omitting the hard parts. This has not been done—the book covers the subject honestly, the newer atomic physics included, and is no "boy's book." It has already met with much approval among teachers and has displaced many other textbooks for first year college use.

$3.90 postpaid.

Course in General Mathematics

By C. H. Currier, Assoc. Prof. Math., Brown University
E. E. Watson, Prof. Math., Iowa State College

READERS who wish to "brush up" on their half forgotten mathematics, or learn more of it, will find this book as suitable as any that is available. Within 392 pages algebra, trigonometry, analytic geometry, and calculus are treated. It presupposes an acquaintance with elementary algebra and plane geometry. The greater part of what students call "useless mental gymnastics"—non-utilitarian mathematical exercises—are omitted and considerable interest has been injected. The book is, however, a textbook, not an "easy method" in mathematics. There is no such thing.

$3.70 postpaid.

A History of Mechanical Invention

By A. P. Usher, Assoc. Prof. Economics, Harvard

HERE is a book for which there is a distinct need in the library of any mechanically inclined person. Other than Byrn's "Progress of Invention in the Nineteenth Century" and Kaempffert's "History of American Invention" there is little that covers the broad field in so complete and comprehensive a manner as does this work. It fills in the lines not stressed in other works, particular attention being given to the development of mechanical elements and trains of mechanism.

The record is traced from earliest time down through the Middle Ages to 1800, but carries the production and distribution of power down to the present. A most admirable and interesting presentation, abundantly illustrated.

$5.20 postpaid.

Protection Against Lightning

By U. S. Bureau of Standards

MUCH misinformation exists as to the real efficacy of methods of protection against lightning. Various theories have been advanced from time to time, most of which have been vigorously denounced as unscientific; even the theories themselves have changed from time to time. Now the one authority in a position to demonstrate the accepted facts, has issued a "Code" which will be welcomed by everyone as the true basis on which to proceed to procure maximum protection. A concise, thorough, and much needed treatise. U. S. Bureau of Standards, Washington, D. C.

25c currency.

The Marine Motor

By F. W. Sterling

A NEW revised edition explaining the why and how of both two cycle and four cycle marine engines. Primarily intended for motor boat owners, the practical discussion of various types of engines makes this book valuable also to automobile owners. Illustrations are abundant, clearly demonstrating the text.

$2.10 postpaid.

Psychology and Profits

By Donald A. Laird

SCIENTIFIC AMERICAN readers will be especially interested in this book because of the author's regular contributions to the magazine on this subject. There is probably no psychologist to-day who is so well identified by his scientific applications to industrial efficiency as Dr. Laird. His eminently practical conclusions have been of great value and widespread interest. Here we have a well written, orderly, and outspoken résumé of his recent work.

$3.70 postpaid.

Men, Money and Motors

By T. F. MacManus, Norman Beasley

TWENTY-FIVE years of the magic rise of the motor industry from the early days of Duryea, Ford, and Haynes as told in the lives of the men who made the history. The most complete picture of the pioneers who did big things and an account of how they did them—all the picturesqueness of the rugged fight for existence.

$3.15 postpaid.

Scientific Sales Management Today

By Charles W. Hoyt

POSTHUMOUSLY published, this is practically the result of an active and successful life devoted to the advance and broadening of advertising in its bigger and higher aspects. No name commanded more respect and attention in the field than that of the author, hence his final opinions are of greatest value.

$4.20 postpaid.

History of Psychology

By W. B. Pillsbury, Prof. Psychology, Univ. Michigan

SO many books on this subject have recently come from the press that one wonders how another angle can be presented. From an abundant experience in teaching in both old world and new, the author possesses a background of association which renders him particularly qualified to weigh the merits of the contributions to man's knowledge of himself from Aristotle to the moderns. A popular history for the general reader.

$3.70 postpaid.

Man The Miracle Maker

By Hendrik Van Loon

IN his inimitable style, enhanced by original sketches, the author tells what man has accomplished since the first dawn by inventions "from skin to skyscraper," "by the taming hand," "from foot to flying machine," "by the thousandwise varied mouth," "by the ear," "by the eye." A unique conception yet logical and conclusive with a tremendous amount of information condensed into small space of text.

$3.65 postpaid.

Andrew Johnson

By Lloyd P. Stryker

DENOMINATED "A Study in Courage" this extended volume traces from birth all the influences which moulded the character of the man who fought Lincoln's enemies, the Radicals, with such valor as to make the conflict an epic. Yet little has hereto been known of him—what he said and did—save for what these same enemies said about him. A splendid contribution to biography.

$6.20 postpaid.

The Cradle of the Deep

By Joan Lowell

MUCH discussion has been engendered by this book as it has formed the basis of an issue between the book publishers and the book clubs. Adults who are not offended by profane expletives where they are an essential part of the description will find this breezy story full of the atmosphere of the sea, ships, and men, although their credulity will be somewhat drawn upon to imagine that so many extraordinary instances can happen to one individual. Nevertheless it is well told and absorbs one's interest throughout.

$3.00 postpaid.

Triumphs of Detection

By George Dilnot

WITH unusual facilities for studying at first hand the operation of criminal detection the author has written several books on "Scotland Yard" and famous cases. Here he presents twenty stories of man-hunts which with their thrilling aspects and variations of operation demanded special methods of detection. Just now we are all interested in the various studies of crime, so an authentic account of Scotland Yard procedure is of particular interest.

$5.20 postpaid.

Stresemann
The Man and the Statesman

By R. von Rheinbaben

WITH a style full of vigor and colorful human interest this experienced writer and politician tells the story of the statesman intelligently devoted to the best interests of his country. A man of varied personal interests, Stresemann offers a wonderful opportunity for a timely biography.

$3.20 postpaid.

Chicago

By C. E. Merriman, Prof. Political Science, Univ. Chicago

HOW Chicago came to be, how political conditions and economic and social forces have changed the cluster of log huts of the thirties into the great midwestern metropolis, is told by the author who has had 28 years experience observing and holding office. A careful and dispassionate view of urban politics.

$3.70 postpaid.

New International Year Book

H. T. Wade, Editor

CONTINUING the yearly issues, now 27 in number, this well established, authoritative work is welcomed by all who have occasion to refer to political, economic, financial, and industrial progress, where accuracy and succinctness are of first importance. The year covered is 1928.

$6.95 postpaid.

An Hour on Health

By Morris Fishbein, Medical Editor, SCIENTIFIC AMERICAN

MUCH has been written on this subject but it is difficult to recall anything so short, succinct, clear, and reasonable as this little book, so crammed full of wise advice and simplicity. The real, accepted facts are given in simple language and the reasoning is such that any layman can comprehend.

$1.10 postpaid.

Famous American Duels

By Don C. Seitz

AN account of the underlying reasons that lead up to and the results of, fourteen famous duels in American history: a practice that continued up to 1880 with participants whose names ranked high in public life. Interesting from an historical standpoint as a study of the times and manners.

$3.65 postpaid.

Corporation Profits

By L. H. Sloan

FOR a study of the size, variation, use, and distribution of corporation profits, this mature and extended work will enable one to get beneath the surface and discriminate for himself just what are the primal facts which form the basis of the mystifying general statements issued for consumption by the public. An arduous and praiseworthy accomplishment.

$3.65 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Employer Restrained From Using Patent

MERELY because an inventor was in the employ of a company at the time his invention was being perfected, provides no cause for the employer to think that he has a license in the invention. In the case of Anton I. Sanbo *versus* the Bear Manufacturing Company, the plaintiff was granted an injunction prohibiting the defendant from further manufacturing and selling his patented device, and from further infringing his patent covering a flat bar type wheel alignment indicator.

An agreement had been made wherein the inventor was to have a royalty for each product manufactured, equal to twice the cost of the materials entering into the completed device. It was also agreed that there were to be frequent statements and accountings, and that any money advanced to the inventor was to be deducted from his royalties.

The defendant contended that it was entitled to an implied license in the invention by virtue of having been an employer of the plaintiff at the time he made the invention. The company also contended that Sanbo had been hired to work for it as superintendent of its machine shop, and that fact entitled the company to manufacture any of his inventions. It was further pointed out by the defense that the inventor was a stockholder and a director of the corporation manufacturing his device, and that his invention should therefore belong to the corporation.

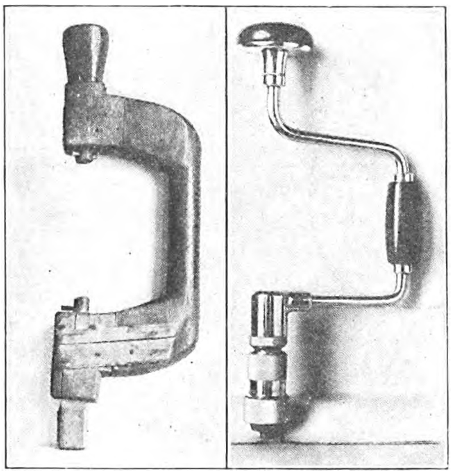
These contentions were disproved, in the opinion of the court, by reason of the fact that there had been a clear understanding between the parties as to their rights. The law governing the rights of an inventor to his invention has long been established, and the mere fact that one is a stockholder, director, or officer of a corporation does not give the corporation any property right in the invention except in cases where there are substantially such relations existing between the person employed and the corporation as would give the corporation a right to the patent because the inventor is an employee.

The Patent Attorney—Friend or Enemy?

UNETHICAL conduct on the part of certain patent attorneys, whose practices place them on the level of auctioneers and vendors of patent medicines, has resulted in the establishment of a code of ethics for the members of the American Patent Law Association. Advertising methods approved by the Association consist of soberly-phrased announcements and business cards conforming to the standards of good taste and propriety one expects in the professions.

Replying to a questionnaire sent to a large number of judges throughout the United States, the judges expressed the opinion that most cases of unethical conduct in connection with inventions and patents could be attributed to attorneys handicapped by youth, inexperience, and ignorance. An unofficial observer might comment that another reason is the prevalence of "go-getter" patent attorneys of the type specializing in great promises and small results. But the common fault is inexperience in the exceedingly intricate procedure to be followed in handling patent cases. Realizing the advantages possessed by patent specialists of long standing, many lawyers without patent experience safeguard the interests of their clients by placing such matters in the hands of reputable patent attorneys.

"A normal baby is usually a phenomenon to its parents. The average inventor feels the same thrill," according to an editorial in a recent issue of *Engineering and Mining Journal*. To save useless time and work it is usually to the advantage of an inventor to discuss with his patent attorney the idea on which he is working. In many cases the advice of an attorney will be of primary importance; the idea may be an old one, with which the prospective inventor would be merely wasting his time. Or he may have conceived an invention of great importance, the significance of which can be best judged by a specialist in the field of invention and patent protection.


Courtesy Museum of the Peaceful Arts

This striking example of progress during the past 200 years forms part of one of the many interesting exhibits at the Museum of the Peaceful Arts, in New York City

Coincidences occur in many unexpected places, and it may be that two or more inventors are engaged in perfecting the same device at almost the same time. If both file patent applications covering the same invention, the Patent Office declares an interference, and it is the duty of the inventors and their attorneys to prove which of them is entitled to the patent. In the absence of contrary proof, the law considers the man who first files an application the inventor.

A preliminary investigation of the prior patents in any particular field may show that the invention is already known, and is probably unpatentable. In many instances valuable information may be found by studying the files in the Patent Office. A more complete examination is made by the Primary Examiner at the Patent Office when the application is received.

If the Primary Examiner points out earlier patents which would invalidate the claims, it is the business of the attorney representing the petitioning inventor to show that the citations do not anticipate the invention in question. Certain claims may be rejected and others allowed; if certain claims are allowed and a patent is issued, the inventor receives a 17-year monopoly covering the use of the claims. If any question of validity arises, the courts must decide if the patent was granted legally. For this reason, it is essential that the application be prepared by an attorney qualified to draw up the papers with faultless phraseology and such well-grounded claims that the patent will withstand any legal battering that may ensue.

Health Food for Fido

THE inventor of an improved dog biscuit has been granted a patent for a product that is rich in vitamines, is preserved from deterioration by a hard glazed crust, and has a longitudinally concave-convex shape. Although the addition of vitamines to food is not new, no one had previously added them to a food to be baked, and so shortened the baking time and modified the baking temperature that the vitamines are conserved and protected by a hard glazed crust. The novel shape serves a useful purpose, for it is easily grasped by the dog when the convex side is upward, or when the concave side is upward it can be easily tipped to a more suitable position for the dog to grasp and bite it.

"Walker on Patents" Revised and Enlarged

THE first edition of "Walker on Patents" was published in 1883 and subsequent editions were published at irregular intervals. For the maintenance of his book as a permanent up-to-date authority on the law of patents for inventions, the author provided that at proper intervals a committee was to select a prominent patent lawyer to revise and enlarge the work and thus maintain it as the standard text-book on the subject. Confronted with the need for a new edition, the committee selected Mr. John L. Lotsch to edit, enlarge, and make the necessary revisions.

Mr. Lotsch's devotion to his task is an honor to the original author and a complete justification of his selection by the committee. He has spent over two and a half years on his revision of the book and the sixth edition has retained all the conspicuous and acknowledged merits of the former editions, while many of the defects and imperfections which impair the usefulness of the work have been removed. Abundant new matter has been added and includes the only completed digests of all cases by the U. S. Supreme Court and the nine Circuit Courts of Appeal of the United States.

The new edition presents in a clear, concise, and simple manner every phase of patent law. The book will be very helpful to the Bench and Bar, and will interest many laymen as well as inventors, manufacturers, and investors in patents.

Inventions of Famous Italians Exhibited

FEW nations have so rich an heritage as that proudly borne by Italy during the past 25 centuries. Always a leader in the fine arts, it has also produced some of the outstanding figures in the field of science and invention. Of these, Leonardo da Vinci and Galilei Galileo occupy places of first rank. Sharing honors with the world-famous inventors of the present generation, these scientific pioneers are the recipients of the plaudits of their countrymen who visit the National Italian Exhibition of History and Science recently opened by King Victor Emanuel in the city of Florence.

Among the exhibits are the oldest telescope in existence, built by Galileo in 1600, and models made from designs by da Vinci of the first flying machines conceived by man. Other models of scientific interest include the first condensation hydrometer, for measuring the humidity of the atmosphere, which was invented by the Grand Duke Ferdinand; the first pendulum clock, invented by Galileo and constructed by Vincenzo; the first thermometers, made by Accademia del Cimento; the first barometer, by Torricelli; and the first immersion microscope, by Amici. Models of da Vinci's parachute, helicopter, and lathe are also on exhibition. Great interest has been shown in the model of an internal combustion engine, made by the monk, Father Barsanti. Many modern inventions are also on display at the National Italian Exhibition, but public interest is focused on the remarkable devices produced more than 500 years ago.

Wanted—A Budding Genius

WHETHER or not the young man to be selected by Thomas A. Edison as his "successor" turns out to be another genius, the far-reaching effect of the competition will stimulate many young inventors. With the announcement that Mr. Edison is canvassing the nation for a young man who can carry on the great inventor's work, all young men with leanings toward mechanics, chemistry, radio, and kindred branches of science have begun to wonder how even a genius can pick a genius.

The young men whose minds have wandered to such thoughts have been in distinguished company, for *Science Service* engaged a number of prominent psychologists to discuss the same question. Forty-eight promising students, scholastic science leaders of their states, will be selected by their governors and sent to the famous Edison laboratories in West Orange, New Jersey, for examination. They well be subjected to a questionnaire, and the winner will receive a scholarship, accompanied by the usual round of honors with which the public awards its heroes, bathing beauties, athletes, and visiting delegates.

Dr. Donald A. Laird of Colgate University doubts if Mr. Edison will uncover a genius of his peculiar caliber, but thinks such a contest will stimulate many young inventors. "His questionnaire will give an approximate measure of the practical general intelligence of the candidates, which is important for inventive genius," in the opinion of Dr. Laird. "But how to measure the emotional drives and real desire for achievement which are also important is still a problem. These non-intelligence factors may be more necessary than mere knowledge and intelligence."

Louis M. Terman of Stanford University, author of "Genetic Studies of Genius," is of the opinion that "it is possible to identify with considerable certainty the youth who is endowed with scientific talent. But," he adds, "the whole bet should not be staked on one horse. If the ten most promising are selected and trained, Mr. Edison will have a better chance of finding ultimately the one individual he wants."

Dr. Knight Dunlap of Johns Hopkins University says, "How would I pick a single genius? I wouldn't. I should pick out a quartile of the class making the best school record . . . but which of these would prove to be a major contributor to the world's progress no one could predict. Mr. Edison might just as well take the brightest boy in Jersey City or in Lancaster and give him the opportunity of becoming an electrical wizard as to carry the quest through 48 states and attempt to pick a potential genius."

"Genius comes in many different forms and there is no general type," according to Dr. Arnold Gesell of Yale University. "Edison has one kind of genius, Einstein another, Kreisler still another. Deliberately to go about finding a successor for any great man it would be necessary to make an inventory of the actual qualities desired and to specify the particular combination in which they are preferred. Genius comes in patterns, not in doses."

Agreeing with several of the other noted psychologists that great care should be taken in choosing the tests to be used on the candidates, Dr. Walter V. Bingham, President of the Psychological Corporation, is of the opinion that Mr. Edison's well-known questionnaires are not sufficiently reliable. With a well-selected series of tests it may be possible to find a mind like Edison's, if there is such a mind in the group, according to Dr. Bingham. But probably he reflects the thought of many others when he frankly states his opinion as to the futility of the search. "There can be no successor to Edison. In his place there will be a whole group of investigators working together. The day has passed when one inventor, no matter how brilliant, can outstrip the organized co-operative efforts of a great research laboratory. But such laboratories need young men of precisely the type Mr. Edison is seeking."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Designs

Design for Lace—Patent 78429. Ben. A. Ball.

Design for a Sign Novelty—Patent 78366. Stanley J. Shepard.

Design for a Combination Bathroom Fixture—Patent 78498. John H. Balmer.

Design for a Stocking—Patent 78524. Ruby Lefi.

Design for a Lamp—Patent 78505. Henry O. Czech.

Design for a Handkerchief Display Rack—Patent 78574. Evelyn L. Hill.

Design for a Lamp—Patent 78578. Paul Kornan.

Design for a Lens Clip or Similar Article—Patent 78594. Vincent Tanassa and Jacob J. Pomeranz.

Design for a Jewelry Display Base—Patent 78568. Leo Flier.

Chemical Processes

Process of Toning Blueprints Green—The blue image being composed of ferrous-ferri-cyanide, the prints are subjected to a solution of uranium salts, potassium ferri-cyanide, and acetic acid, until the blue turns to a green, and then washed in water. Patent 1712428. Rudolf Fritsche.

Mineral Feed and Process for Making Same—For animals, which comprises heating rock phosphate and acid sulfate to a temperature above 300° C., cooling the mixture, and adding water, limestone, charcoal and salt to form a paste, to be cut and dried into pellets. Patent 1712404. Virgil R. Rupp.

Electrical Devices

Electric Furnace—For producing calcium carbide from a mixture of lime and carbon, at the same time allowing the waste heat and products of combustion to be utilized for treating shale, so that liquid hydro-carbons may be gained as a by-product. Patent 1711088. Hilliary Eldridge.

Time Switch—So arranged as to allow an alarm clock to close an electric circuit at a predetermined time, to open the circuit at a later time, and to intermittently operate as for show windows or advertising schemes. Patent 1710111. Manuel H. Rodrigues.

Electric Lamp and Shade Adjuster—Which may be associated with the conventional electric lamp and shade and will provide a means whereby the lamp and shade may be adjusted to throw light in any direction. Patent 1714369. Frederick A. Howe, Jr. and William Hinchliffe.

Conductor-Retrieving Device for Vacuum Cleaners—A device capable of being incorporated in a vacuum cleaner of any conventional form, for retrieving the electrical conducting cord so that it may be varied at will as the cleaner is moved about a room. Patent 1714225. Parke S. Hyde and Damon P. Raynolds.

Switch Plate—A glass switch plate, adapted for a duplex receptacle switch and having a structure for receiving a fastening screw for holding the plate in position and without engaging the fastening screw with the glass. Patent 1715222. Nathan Chesler.

Motor and Motor Switch for Flashers and the Like—For different electric devices, such as flashers for signs, and the like, so constructed as to be readily adjusted to cause the flash to move at different speeds, and to use a minimum amount of current. Patent 1714321. Stephen H. Sharpsteen.

Of Interest to Farmers

Fence Post—Having a self-locking means for securing fencing materials in position in a quick and easy manner, several of the horizontally disposed portions of fencing being simultaneously secured in one locking movement without the use of extraneous fastenings. Patent 1714388. James McBride.

Of General Interest

Loose-Leaf Binder—Having rigid telescopic connecting members in place of the usual straps, connecting the members directly to the top and bottom cover sections and the back by resilient elements which operate automatically to adjust the covers. Patent 1710450. Frank H. Crump.

Eyeglass Cleaner and Polisher—Having bulged pockets, supported on pivotally connected arms, for the reception of the thumb and finger of the hand, so as to press said pockets against opposite surfaces of an eyeglass for polishing purposes. Patent 1712325. David Brandfon.

Design Generation—By an instrument of the kaleidoscope type, whereby various units of a design may be produced not only as suggestions, but may be preserved exactly as they appear, except possibly for variations of color, by photography. Patent 1712431. Walter C. Hadley.

Combination Shelf and Clothesrack—Which may be readily inserted in a clothes closet or locker and the clothes held free from the walls so that air may circulate therethrough, and any article removed without disturbing others. Patent 1711854. Milton M. Olander.

Clinging Figure—Having flexible limbs extending therefrom and suction cups formed integral with the extremities thereof whereby the suction cups constitute both hands and feet simulations and surface attaching means. Patent 1710989. Andrew Kelly.

Hair Curler—Consisting of a single piece of material foldable into two sections for enclosing a portion of hair and firmly grasping all the hair ends, thus curling the hair clear to the ends. Patent 1710216. Edna L. James.

Casement Window—So constructed that it may be hung with a minimum amount of labor, and which has means for supporting itself in the window frame to permit the carpenter to use both hands in securing the sash. Patent 1710171. John Lindsay.

Combined Refrigerator and Display Stand—Having a plurality of slidably mounted baskets for displaying fruits and vegetables in such manner that the air may circulate freely therethrough, and a refrigerating compartment for housing such articles as are easily destroyed by exposure. Patent 1711921. Norton H. Connell and Mion McMahan.

Combination Dishpan — A combination rectangular pan for washing and draining, comprising two sections adapted for arrangement within a kitchen sink, one section presenting a receptacle for washing water, the other having a perforated bottom supported on legs, for draining. Patent 1711731. Mathilde Hein.

Ring—In which a plurality of annular sections are rotatably joined together for displaying various combinations of stones, the ring is of neat and attractive appearance devoid of projections on either inner or outer surfaces. Patent 1712417. George Beaujard, Jr.

Price Ticket Holder—Which may be quickly attached to and detached from a suitable support, the price ticket or card readily inserted or removed, and the whole manufactured with economy as regards material. Patent 1712423. Francis Devins.

Face Pack—Constructed to snugly conform to and completely cover the chin and face sides, for treating the face with hot and cold applications to soften the beard incident to shaving, yet leaving the operators hands free. Patent 1709936. Wilbert L. Drew.

Valve—Particularly adapted for controlling the flow of water to a fire hose, it may be adjustably set to prevent the delivery of fluid therethrough above a predetermined pressure, and locked against unauthorized tampering. Patent 1712298. Thomas B. Ford.

Jewelers' Imitation-gem Display Book—The leaves of which are provided with apertures so correlated that as each leaf is displayed the stones of all the leaves therebeneath, as well as the stones attached, will be exposed to view. Patent 1709937. Charles E. Everard.

Furniture - Covering - Pad Connecter—Which, in addition to securely locking a plurality of table cover sections in co-related or adjusted position, includes means for readily effecting the release of the sections. Patent 1712320. Jacob Zitzerman.

Propeller Guard—A pair of cages, adapted to be removably secured on either side of the propeller of a boat used for diving purposes, to prevent the life line and hose connection of a diver's outfit fowling. Patent 1713446. Gabull Peterson.

Cooker—Having a vertically adjustable food supporter whereby the food may be held at any desired point above the cooker bottom, and wherein an even degree of heat will be transmitted, and the fuel consumption reduced. Patent 1712926. Tennie Lowe-Lile.

Salt-Bath Furnace—Whereby the molten salt is kept at the desired temperature for hardening steel in a non-decarburizing condition, which consists in the introduction of an acid, non-volatile oxide, preferably silica, in contact with the salt. Patent 1713472. Axel G. E. Hultgren.

Ornamental Building—A structure of conical form, having doors and windows near its base, and depicting an edible ice cream cone, with means for illuminating the exterior by projected lights to harmonize with the cone and colors of the ice cream. Patent 1713050. George H. Natzel and Frank E. Jackson.

Spring Action for Firearm Hammers—Capable of application to all types of firearms, when applied to automatic pistols, dispenses with the comparatively complicated spring action embodied in the grip, and in the heavier types permits the grip to be reduced in size. Patent 1711874. Archibald R. Brinkerhoff.

Holding Ring for Compact Plates—An L or Z shaped ring in cross section, for holding compact plates in position, the construction being such that projections from part of the ring act as yielding locking means for holding the compact plate in position. Patent 1714376. William G. Kendall.

Surface Finisher—Including a finishing head to be slid back and forth over a floor or other surface being worked upon, and a hollow manipulating handle which constitutes a reservoir for the liquid used in the finishing operation. Patent 1714350. Harold de Jong.

Folding Chair—Having a back frame element with which a seat and supporting legs are foldably connected in such manner as to lie wholly within the confines of the back, and occupy a minimum of space in storage. Patent 1714323. Finn Simmons.

Packing Cover—Made of rigid or semi-rigid material, in a completed or knock-down form ready for assembly for the protection of delicate parts and adjustments of a typewriter, while in the process of packing or in transit. Patent 1737724. James P. Ward.

Container—For powdered or granular material, having two relatively rotatable sections which permit the discharge of the contents when uncovered, without likelihood of the openings becoming clogged should the contents become moist. Patent 1714368. Arthur W. Hobson.

Soap Chipper—Whereby a housewife may slice up into ribbon-like chips her favorite brand of soap instead of being obliged to use soap flakes of the brands usually sold on the market. Patent 1714413. John A. Woodward and Leo M. Greany.

Swab Holder and Swab Therefor—Comprising a pair of forked extensions for receiving a tubular element and maintaining the same under tension, adapted for use in holding a tooth brush, a medical swab, or other purposes where such a handle may be applied. Patent 1713815. Joseph T. Berthelote.

Hardware and Tools

Shears—Embodying crossed blades having arms provided with finger loops and shoulders and edges so formed that they permit the normal cutting of hair but prevent pinching or cutting the ears or other parts of the head. Patent 1710456. Henry W. Latimer.

Speed Wrench—Having mechanism functioning by the action of inertia to automatically cause rotation of the stock to continue through an uncertain interval of time thereby greatly facilitating the labor of releasing tightly bound nuts. Patent 1710198. Emil Torgerson.

Pipe-Bending Tool—Which may be set on any size pipe up to and including three-fourths of an inch at any angle to a curve, whereby the bend is to be changed in form, is particularly adapted for electric conduits. Patent 1712414. Andrew B. Allen.

Can Punch and Vent—For punching a plurality of holes in the head of a can which may be used for pouring the contents from the can, and for venting the can, and sealing the openings when the can is not in use. Patent 1709514. Charles W. Bassett and Edna M Bassett.

Combination Drill and Countersink—Comprising a drilling portion, a countersinking portion, and a stop, in one single-piece unit, so arranged that the unit may be economically manufactured, for use in the drilling of brake linings. Patent 1711012. Rudolph Brandt.

Screw Driver Attachment—For preventing slippage between the screw driver and the screw, the attachment automatically giving way and freeing the screw as the screw is driven home, is readily applied to any standard screw driver. Patent 1712196. William A. Burger and Raymond B. Callahan.

Sash-Cord Anchor—In the form of a metal plate detachably secured to the inner face of the stile which enables the attachment to be made or the cord released without removing the sash or disturbing any part of the frame. Patent 1713422. Jacob A. Cohen.

Wrench—Having the dual properties of a pipe wrench and a nut wrench and quickly adjustable means for the jaws in either use, the handle and jaws acting as a compound lever to cause the jaws to grip any object. Patent 1713038. Amos K. Ersland.

Painting and Decorating Tool—Or hand machine adapted for striping, stenciling and straight surface painting, the tool including a fluid reservoir and novel paint feeding and applying means, and may be readily used by those unskilled in the work. Patent 1713750. Allen H. Dow.

Can Opener—Having a supporting plate upon which a can may rest, and a standard carrying a blade for cutting the can top, and means for rolling the cut edge so that it will be continuously smooth. Patent 1713823. Henry J. Edlund.

Heating and Lighting

Fireplace—The hearth of which is raised a slight distance above a floor, a well depressed below the level of the hearth and air ducts communicating with the well for deflecting practically all the heat into the room. Patent 1711099. Samuel A. Ford and Richard Waldie.

Furnace Utilizing Forced Draft—So arranged as to cause a constant pressure of steam in the boiler, the steam pressure controlling the draft passing through the grate, and the draft controlling the fuel supply to the combustion chamber. Patent 1714432. Elmer A. McArthur.

Machines and Mechanical Devices

Mechanical Movement—A vertically reciprocating float readily raised by the waves and falling by gravity, and means whereby the rising and falling will be guided between racks thus generating power on both upward and downward strokes. Patent 1711103. Richard B. Smith.

Refrigerating System—Comprising means for circulating a refrigerant fluid, whereby the refrigeration of the circulated medium is stopped whenever the pressure of the circulated medium increases or decreases between certain limits, thereby preventing the freezing up of the coolers. The inventor has been granted two patents, 1712567 and 1712568. Richard W. Kritzer.

Textile-Finishing Machine—Which operates to smooth the fabric and impart a high luster and natural sheen on both sides of the cloth during a single running, and whereby a uniform pull is exerted in feeding the cloth through the machine. Patent 1712308. Frederick W. P. Rose and Christian Werner.

Woodworking Machine—Capable of being readily converted into a rotary disk saw machine, a reciprocating scroll saw machine, and a wood turning lathe, also functioning as a grinding wheel, buffer, polishing wheel and drill. Patent 1711077. Henri C. Babize.

Glass-Serving Apparatus—For use in connection with automatic bottle making machines, for flowing a molten slug of glass from the furnace into a container in such manner that the hot end will be subsequently arranged adjacent the moulding form. Patent 1712327. Homer Brooke.

Power-Multiplying Mechanism—Which provides a simple means for transmitting power from one point to another through levers, and whereby a comparatively long stroke is translated into a power thrust of short strokes with a minimum loss in transmission. Patent 1712444. Douglas F. Maltby.

Soldering Machine—For soldering the corners of metal doors or similar articles, a universally adjustable work holder being provided to which the door is secured, and the corners immersed first in an acid pot and then in a solder pot. Patent 1712443. Louis Liebman.

Aspirating Device—Comprising a closed casing formed of telescoped tubular sections detachably joined in concentric relation providing a fluid pressure receiving chamber housing an aspirating tube as applicable to so called "vacuum cleaners." Patent 1712425. Henry S. Earnest.

Sound-Reproducing and Picture-Exhibiting Apparatus—Whereby the microphone of a radio circuit and an amplifying horn are employed for permitting sound to be distributed simultaneously with the act of projecting pictures of objects or scenes upon an exhibiting screen. Patent 1710994. Albert T. Marshall.

Automatic Stop for Tabulating Machines—Which can be attached to any standard type of machine and set to permit tabulation of any desired number of lines and then automatically stop, the operation may be repeated as often as desired. Patent 1712901. Robert E. Paris.

Propeller for Surface Water Craft—Whereby oppositely driven propellers are arranged side by side, each mounted in such manner as to dispose only the lower part of each blade in the water, when the boat attains its maximum speed. Patent 1713448. William J. Roe.

Sound-Reproducing Machine—Comprising a plurality of record disc carrying tables, a continuously driven shaft and a pair of auxiliary shafts, for automatically changing the discs whereby a continuity of reproductions of a series of records may be obtained. Patent 1713481. Luigi Robimarga.

Stage Lift Flowing Device—A combination differential and velocity fluid pressure control device or valve, designed to open and close by the velocity and pressure of a liquid column to control the flow of liquid. Patent 1712418. Alexander Boynton.

Guard for Paper-Winding Machines—Of the double drum type, which automatically conforms to the size of the roll as it is being wound, and when wound may be swung to an out-of-the-way position for the removal of the finished roll, and replacement of a new core. Patent 1713382. John C. Hammel and William O. Dickinson.

Grommet-Making Machine—Wherein the strands of rope are fed into the machine by hand, and held in place while applied to a mandrel, and acted on in such manner that a grommet will be formed thicker than the strands used. Patent 1714339. William A. Young and Roland L. Ankener.

Paint Mixer—Comprising means for detachably supporting in a rotatable vertical operative position upon a container, a paddle formed from bent wire loops, for quickly remixing ready-mixed paint, which by reason of standing has settled. Patent 1714436. Harold S. Rambo.

Medical and Surgical Devices

Dental Tool—A power driven reciprocating file, which is particularly helpful for cutting down the abutting faces of adjacent teeth, and smoothing off fillings or preparing a tooth for filling. Patent 1712469. Willard B. Force.

Prime Movers and Their Accessories

Thermostatic Valve Control—For controlling water flow, especially adapted to be used in connection with a motor and a radiator for automatically closing the circuit of water, whereby the motor may be warmed up more readily. Patent 1711901. Adolph O. Nelson.

Combined Steam Electric Drive for Generator Sets—An arrangement of steam and electric power drive providing full and flexible accommodation to generator load and shaft torque with a balanced distribution of the load on the shaft. Patent 1714449. Ralph E. Royse.

Safety Dashpot—For use in conjunction with centrifugal governors now in common use on steam engines, turbines and electric generators, for providing a proper damping effect while permitting quick movement under unusual circumstances. Patent 1714431. Olovg Lissen.

Railways and Their Accessories

Crossing Gate—Including a fixed frame structure, and two units arranged at the crossing approaches and operated by the train to close the gates while the train is passing, and open the gates when the train has passed. Patent 1712441. Louis Lamagna and Albino Botta.

Railway Tie and Rail Seat—A concrete tie adequately re-inforced at the points of greatest strain, and in addition having a base forming a seat resisting upward displacement and offering compensation and adjustment for wear both in rail tread and seat. Patent 1713454. John E. Springer.

Pertaining to Recreation

Toy Parachute—In the nature of a ball composed of sections held together for a predetermined length of time by suction, but separating after the ball is thrown in the air, and forming a parachute which will slowly descend. Patent 1713432. Theodore G. Griggs.

Dancing Toy—Doll figures supported in such relation to the rotary turn table of a phonograph that the operation of the phonograph will produce motion simulating dancing in consonance with the music. Patent 1713430. Isaac W. Furman.

Exercise Bar—A strong durable bar, which may be used as an ordinary gymnastic wand except that it may be extended and collapsed during exercising movements, or the members locked at any given length, forming a rigid bar. Patent 1714391. Robert B. McWhirter.

Pertaining to Vehicles

Signal—An automatic electrically operated signal whereby the driver of a motor vehicle may readily ascertain whether or not the usual tail and signal lights are functioning. Patent 1712395. Alexander M. Miller.

Automobile Light Indicator—Particularly adapted for association with the lighting circuits, to positively indicate to the operator whether the head and tail lights are illuminated when intended so that should any one light be extinguished it will be indicated to the driver. Patent 1713051. John A. Oya.

Apparatus for Use in Cleaning and Polishing Automobiles—By which the performance of the several operations necessary in cleaning and polishing an automobile both interiorly and exteriorly is greatly facilitated, and on a relatively small area of ground. Patent 1713014. Louis J. Wilde and Bee K. Gillespie.

Safety Device for Automobiles—Which swings a guard member, arranged in front of the bumper, to push a pedestrian out of the way when an accident is imminent and automatically applies the brake, the operating lever being actuated from the driver's seat. Patent 1713403. Walter Sniatowski.

Dust Guard—Or mud guard, for automobiles or other vehicles, constructed of resilient material throughout, and of such consistency that it will yield and then return to form after an appreciable blow. Patent 1713405. Arthur V. Stansfeld.

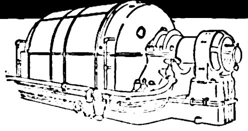
Camping Outfit for Automobilists—Constituting articles such as a table, stools, and storage receptacles for food, all of which may be nested as a single unit and carried trunk-like on an appropriate and quickly accessible part of an automobile. Patent 1712213. Horace W. Janicke.

Truck—A two wheeled truck adapted to support the forward end of a two wheeled cart, capable of a wide range of utility, but particularly forming a supporting and traction means for the conventional Cuban cane cart. Patent 1714383. Ricardo Leon.

Jacking Apparatus for Trailers—Which will elevate the trailer to disconnect the coupling with the tractor, and will support said trailer in elevated position while it is being loaded or unloaded, thereby relieving the tractor for other work. Patent 1715236. John A. Higgins.

Valve—For pneumatic tires, wherein the seating member is held against the valve seat by a screw connection with the valve casing, instead of the usual spring actuated seating member. Patent 1713889. Walter H. Criswell and Leslie W. Bond.

Many Well-Known Men Have Helped To Prepare These ELECTRICAL COURSES



Endorsed by Thomas A. Edison

Endorsed by Charles P. Steinmetz

Nearly $200,000 has been spent in the preparation of the Electrical Courses of the International Correspondence Schools.

They have helped thousands of men to get good positions in this fascinating profession for two reasons. (1) They are specially designed to meet the needs of the student who studies at home. (2) They are written by *practical men.*

Here are just a few of the men who have contributed to these courses:

Edgar Knowlton—Electrical Engineer, Alternating Current Engineering Department, General Electric Co.

J. Lester Woodbridge, E.D. and M.E.—Chief Engineer of the Electric Storage Battery Co.

O. J. Bushnell—Superintendent of the Meter Department, Commonwealth Edison Co.

S. A. Fletcher—Electrical Engineer, Superintendent of Service, Alabama Power Co.

H. B. Gear, A.B., M.E.—Engineer of Distribution, Assistant to Vice-president, Commonwealth Edison Co., Chicago.

C. E. Knox—Consulting Engineer on the Woolworth Building, New York. Author of "Electric Light Wiring."

G. E. Parham, M.E.—Electrical Engineer, General Foreman, the Brooklyn-Manhattan Transit Corporation.

S. H. Mortenson—Designer of Alternating Current Motors and Generators, Allis-Chalmers Manufacturing Co.

When you read over a list like that, you know why these I. C. S. Electrical Courses have been endorsed by Edison and Steinmetz . . . you can see why we say they will help *you.*

Just mark and mail the coupon printed below and we'll gladly send you a Free Booklet telling all about these I. C. S. Electrical Courses or any other course in which you are interested.

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 6109-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, **"Who Wins and Why,"** and tell me how I can qualify for the position, or in the subject, *before* which I have marked an X:

☐ **Electrical Engineer**
☐ **Electrician**
☐ **Electric Wiring**
☐ **Electric Lighting**
☐ **Electric Draftsman**
☐ **Electric Car Running**
☐ **Electric Machine Designer**
☐ **Radio**

☐ Architect
☐ Architectural Draftsman
☐ Building Foreman
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Telegraph Engineer
☐ Telephone Work
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Patternmaker
☐ Civil Engineer
☐ Surveying and Mapping
☐ Bridge Engineer
☐ Gas Engine Operating
☐ Automobile Work
☐ Aviation Engines
☐ Plumber and Steam Fitter
☐ Plumbing Inspector
☐ Foreman Plumber
☐ Heating and Ventilation
☐ Sheet-Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration Engineer
☐ R. R. Positions
☐ Highway Engineer
☐ Chemistry ☐ Pharmacy
☐ Coal Mining Engineer
☐ Navigation ☐ Assayer
☐ Iron and Steel Worker
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Agriculture ☐ Fruit Growing
☐ Poultry Farming
☐ Mathematics ☐ Radio

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C.P.A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Grade School Subjects
☐ High School Subjects
☐ Illustrating ☐ Cartooning
☐ Lumber Dealer

Name...
Street Address...
City.................................... State....................................
Occupation...

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—AUGUST, 1929

American Lead Pencil Co. 182
American Pipe Bending Machine Co. 183
Apparatus Engineering Company 185

Bartlett-Hayward Company 177
Bauer & Black 183
Bernard & Heller 184
Charles Bond Company 184
Box 190 181

Chicago Stock Gear Works 184
Chicago Technical College 184
Crescent Tool Company 183

Dodge Brothers Trucks .... Second Cover

Elec. Service & Eng. Bureau (P. O. Box 132) ... 184
Ethyl Gasoline Corporation 171

Ford Motor Company (Aviation) 102

Gillette Safety Razor Company 98

International Correspondence Schools 192
International Ticket Scale Corp. 183

Keasbey & Mattison 184

Laboratory Materials Company 183
La Salle Extension University 184
E. Leitz, Inc. 185

Masonite Corporation 169
Matthews Company 184
Metallic Sign Letter Co. 184
Milwaukee Die Casting Company 179
Wm. Mogey & Sons, Inc. 183
Munn & Co. .... 181 & 184

National Automotive School 183
National Electric School 182
New Method Mfg. Company 181

Packard Motor Car Company .... Third Cover
Pratt Institute 184

R. J. Reynolds Tobacco Company ..... Fourth Cover
G. F. R. 184
Ruxton Multi-Vider Corp. 180

Schwerdtle Stamp Company 180
Science News-Letter 185
Charles A. Scott 184
Sears, Roebuck & Co. 180
S K F Industries, Inc. 97
Stephenson Laboratory 184

Timken Roller Bearing Company 100

Unisol Mfg. Company 183

Veeder-Root, Inc. 181
Paul Von Boeckmann 185

Western Electric Company 173
Westinghouse Electric & Mfg. Company 175

Henry Zuhr, Inc. 184

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

Editorial Staff

ORSON D. MUNN, Editor

Albert A. Hopkins
Albert G. Ingalls
Louis S. Treadwell
A. P. Peck
F. D. McHugh
Henry W. Hough
Professor Henry Norris Russell
Professor Alexander Klemin

Corresponding Editors

Ernest W. Brown, Sterling Professor of Mathematics, Yale University.

A. E. Buchanan, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

Morris Fishbein, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia.*

William K. Gregory, Professor of Vertebrate Paleontology, Columbia University.

Leon A. Hausman, Professor of Zoology, New Jersey College for Women.

Paul R. Heyl, Physicist, United States Bureau of Standards.

David Starr Jordan, Chancellor Emeritus, Leland Stanford Jr. University.

Waldemar Kaempffert, Director Rosenwald Industrial Museum, Chicago.

M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MacDougal, Associate in Plant Biology, Carnegie Institution of Washington.

Roy W. Miner, American Museum of Natural History.

Russell W. Porter, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

Dr. Walter Franklin Prince, Research Officer, Boston Society for Psychic Research.

Elihu Thomson, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. Wood, Professor of Experimental Physics, Johns Hopkins University.

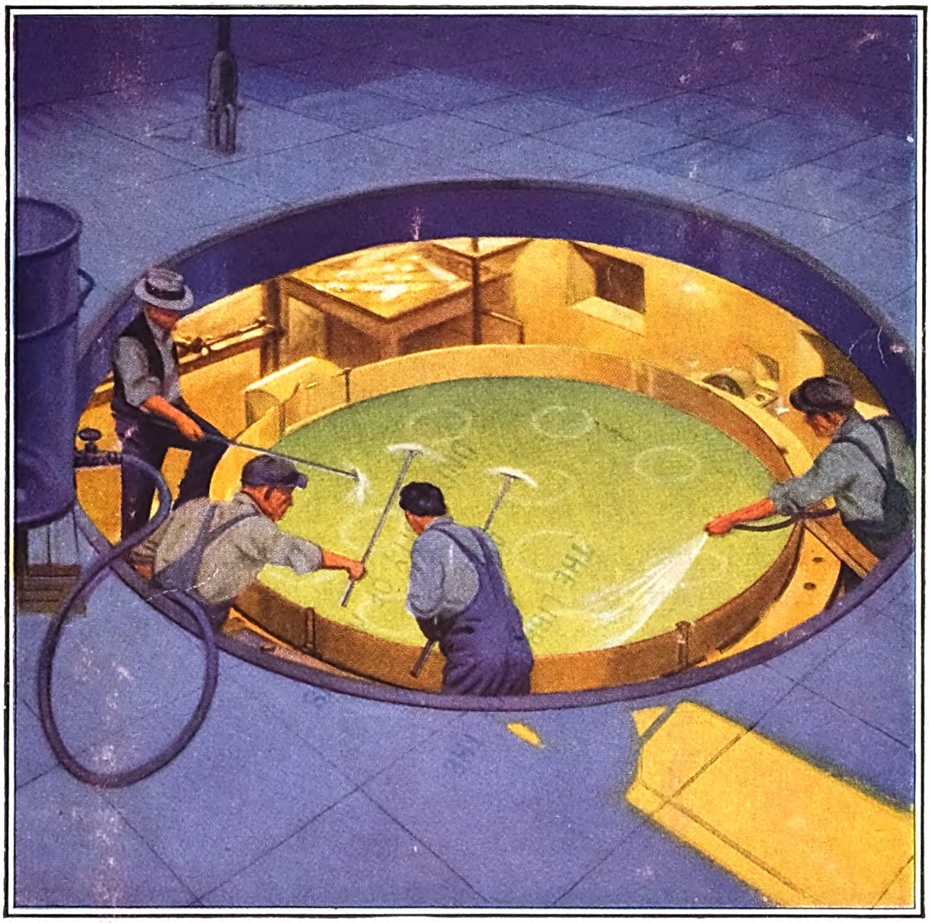
Vol. 141, No. 2. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

05
A
Enging

SCIENTIFIC AMERICAN

September 1929

35¢ a Copy



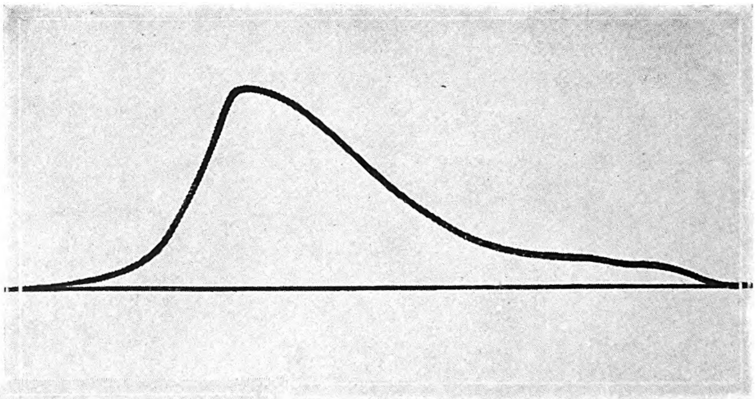
SILVERING LARGEST TELESCOPE MIRROR

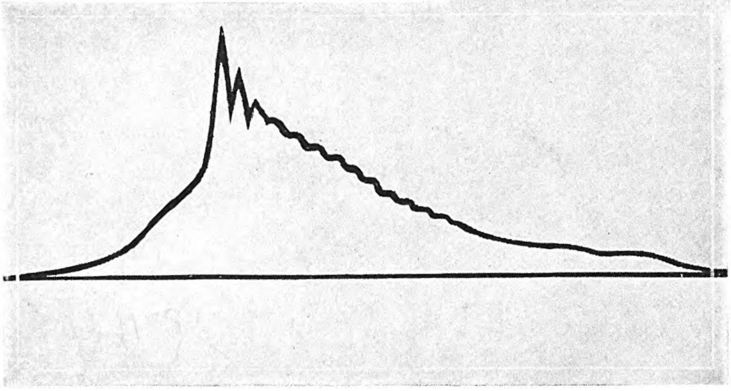
IS THE AIRPLANE DIESEL PRACTICAL?

STEAM VERSUS WATER POWER

What is that "Knock"?

This is what happens in the cylinder of a gasoline engine when it is running smoothly. The pressure gradually increases after ignition until the mixture is nearly all burned. Then it grows less and less.





But when the gasoline is causing the engine to "knock," just see what happens. Is it any wonder that the engine loses power? Ethyl Gasoline prevents that jagged saw-tooth by "knocking out that knock."

THE "knock" was a mystery in the automotive world until the scientists in General Motors Research Laboratories started on its trail. Before they finished they not only found out what that elusive "knock" was, but were actually able to take a picture of it!

This was made possible by the development of the Midgley Indicator, which records the pressure inside the cylinder of a gasoline engine. It was this ingenious device which first revealed the truth—that the "knock" was caused not by the engine, but by inherent faults in gasoline itself.

It showed that gasoline, when compressed beyond certain limits, explodes too fast—that is, "knocks" and loses power. Then the problem was to find something to mix with gasoline to control its combustion rate as compression was raised. After years of research it was found that Ethyl fluid, containing tetraethyl lead, was the solution.

Today leading oil companies mix Ethyl fluid with their gasoline to form Ethyl Gasoline. Ethyl made possible the engines of higher compression now on the market. By eliminating "knock" in engines of average compression it brings out additional power, gives them a new resiliency and nimbleness impossible to obtain with ordinary gasoline. Ride with Ethyl.

ETHYL GASOLINE CORPORATION · 25 Broadway, New York City
56 Church Street, Toronto, Can. · 36 Queen Anne's Gate, London, Eng.

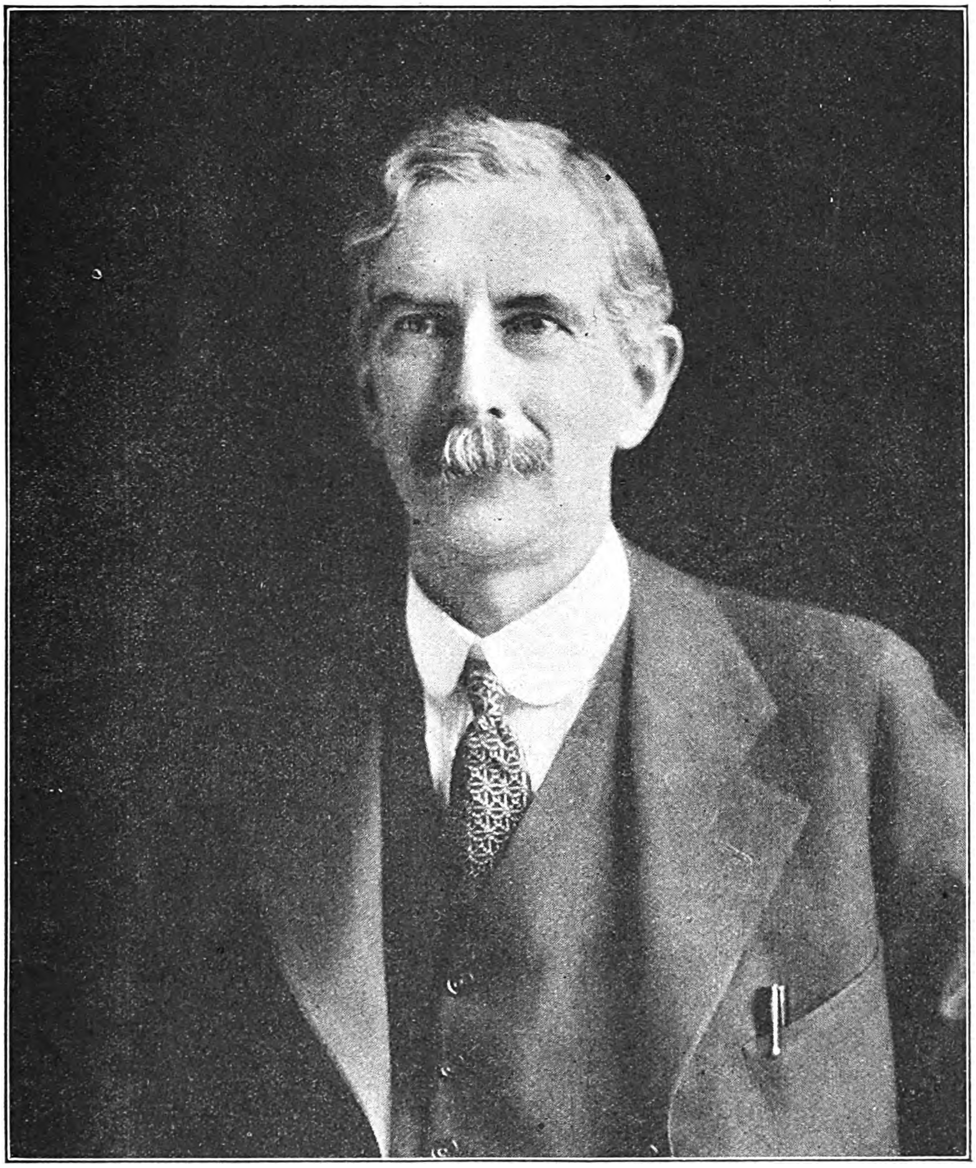
ETHYL

GOOD GASOLINE *plus* ETHYL FLUID *equals* ETHYL GASOLINE

Knocks out that "knock"

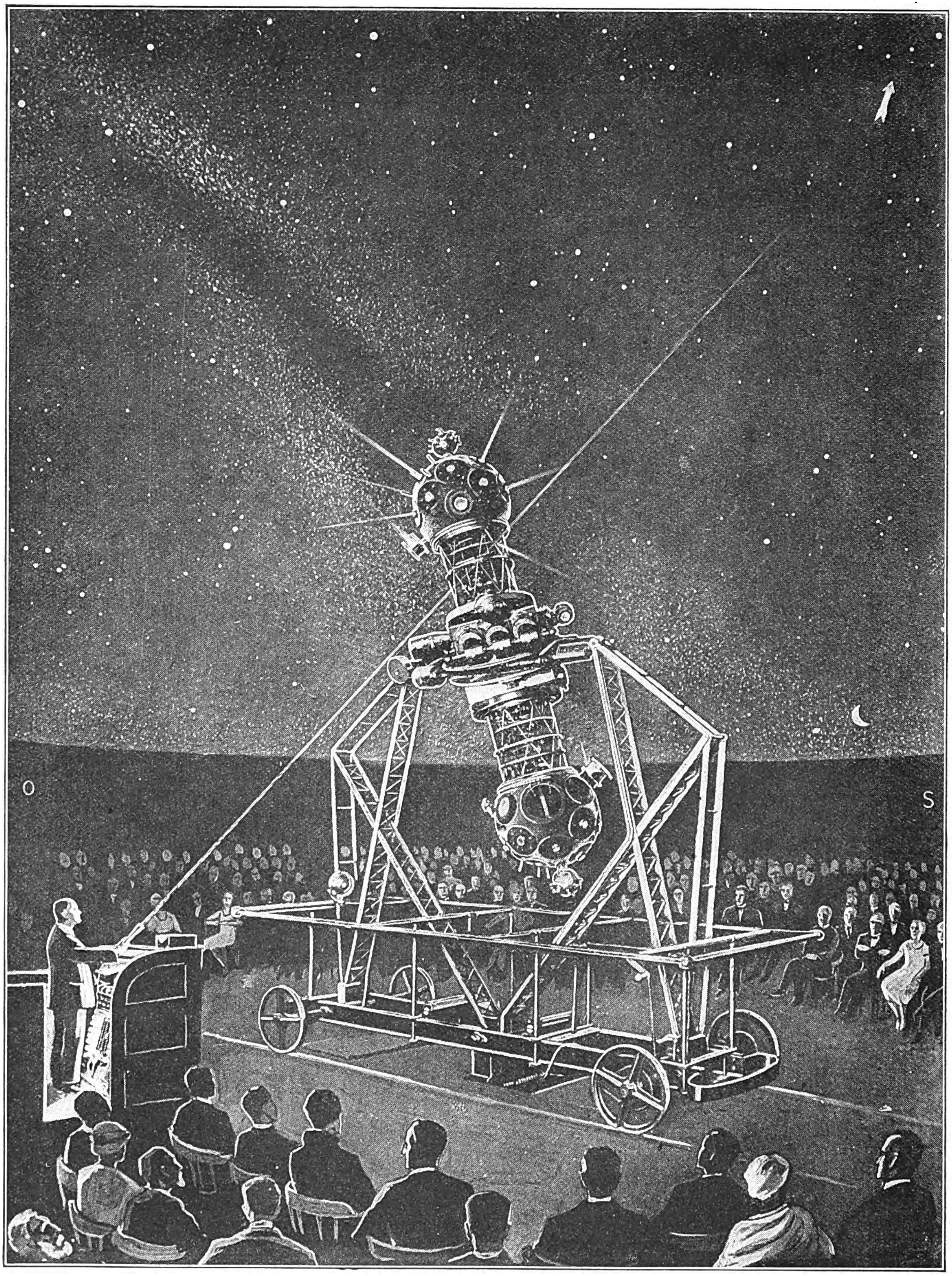
GASOLINE

© E. G. C. 1929



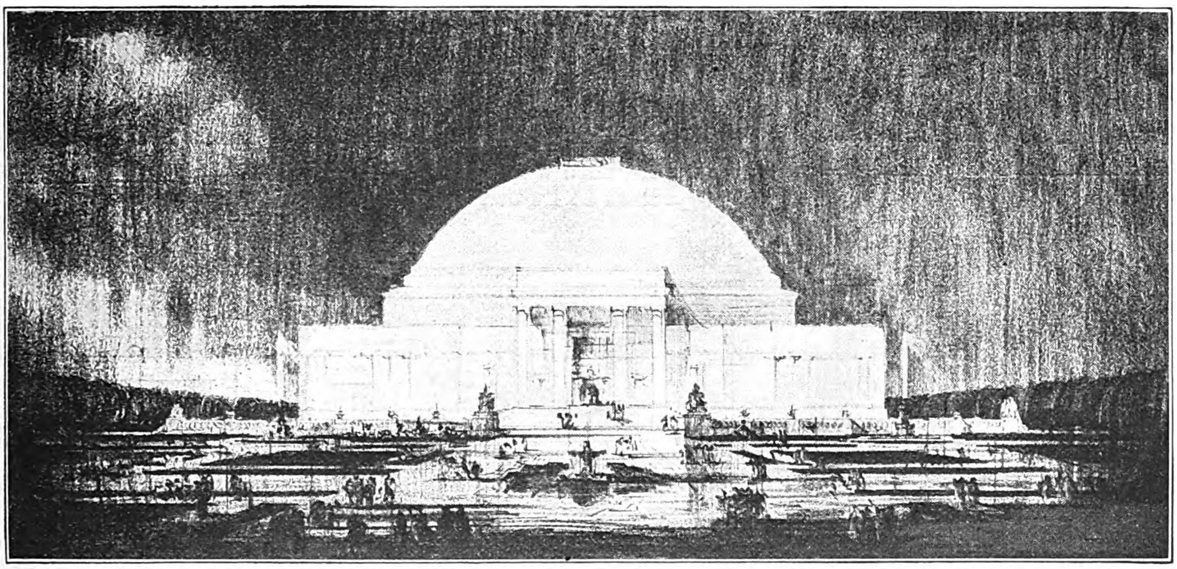
Charles G. Abbot

"SOLAR physics; infra-red solar spectrum; solar constant of radiation; variability of the sun and of terrestrial temperature; utilization of solar heat." "American Men of Science" thus lists unusual corners of science in which runs the career of the distinguished scientist whose photograph appears above. Obviously they center around the study of the sun. In 1928, Dr. Abbot was placed at the head of the famous Smithsonian Institution. Despite the demands of this administrative position he continues his research. He has proved that the sun is a variable star like many others of the stars, and he has published evidence indicating that the earth's climate varies consequently in a predictable manner. Dr. Abbot has written, among other books, "The Sun," recently revised, and "The Earth and the Stars." Both treat of the sun from many aspects, especially as the earth's heat source; also of solar engines for power purposes. Dr. Abbot has invented several instruments widely used. His solar cooker and his fly-wing star radiometer for measuring the heat of the stars are celebrated.



The Planetarium, and the Lecturer Using an Electric Pointer

AS we enter the rotunda a white dome spreads over our heads. The white dome presently dims and vanishes into a light blue canopy above. A mysterious silence descends upon the spectators. The sun and his family, and the moon, appear in the sky. The faint humming of the motors is heard. The stars begin to execute their diurnal motion. The sun sets, and the starry heavens burst into radiance. All this is magically produced by the projector shown



THE NEW PLANETARIUM FOR CHICAGO

Max Adler, a former Sears-Roebuck official, generously gave Chicago 500,000 dollars to purchase a Zeiss planetarium for that city. It will be on an island near the Field Museum. Samuel S. Fels, philanthropist, has just provided a planetarium for Philadelphia, and other cities have become interested

Canned Astronomy

What the New Planetariums for Chicago and Philadelphia Will Be Like

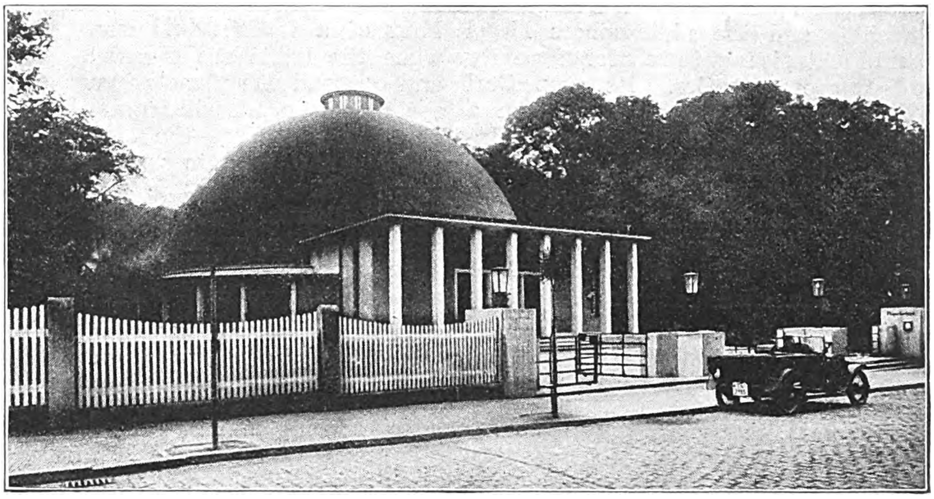
By ALBERT G. INGALLS

WITHIN the year Chicago and Philadelphia are to have the first American planetariums — Chicago on a small island near the famous Field Museum; Philadelphia as a part of the new Science Museum of the Franklin Institute. From the day of opening of these two mechanical marvels, public interest in planetariums is certain to reach a new level all over the nation.

It is said that no one ever sees a planetarium without wishing there was one in his own community. Certain it is that no one of scientific turn of mind has ever been known to leave a planetarium performance disappointed. It is one of the things that really outdo expectation. People who go to one, hoping thus to disentangle their mental misconceptions regarding the complicated relations and motions of the heavenly bodies, find that they have not only been instructed but entertained. For the planetarium is a good show. Even a person without the least scientific interest in astronomy would find it so. Intrinsically the performance is esthetic. It provides thrills while it educates.

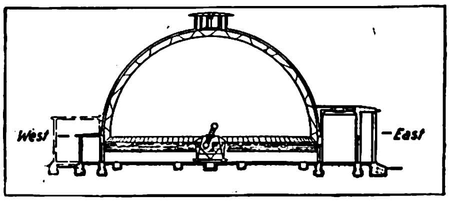
You can not adequately describe this performance; you must see it. As a controlled mechanical reproduction of the universe, with the mechanics in the background, it is well nigh perfect. The sun sets like the real sun. Twilight fades into night as smoothly as Nature's twilight. And the night—what a night! Except in the desert you will not see such nights—certain it is that you will never see the stars so clearly in any city. Your first impulse on emerging from the planetarium will be to send a telegram back home stating that your city *must* have one at once; and you will begin as soon as you are home from Chicago or Philadelphia, making appointments to see influential people in the interest of acquiring one of these miracles for your city. Education alone will justify the purchase. Even though the price is high, some 75,000 dollars for the projector without the building, you will want your own community to have one.

At present the only way to see a planetarium is to go to Europe, especially Germany where they were invented and developed, and where they are made. Fifteen German cities now

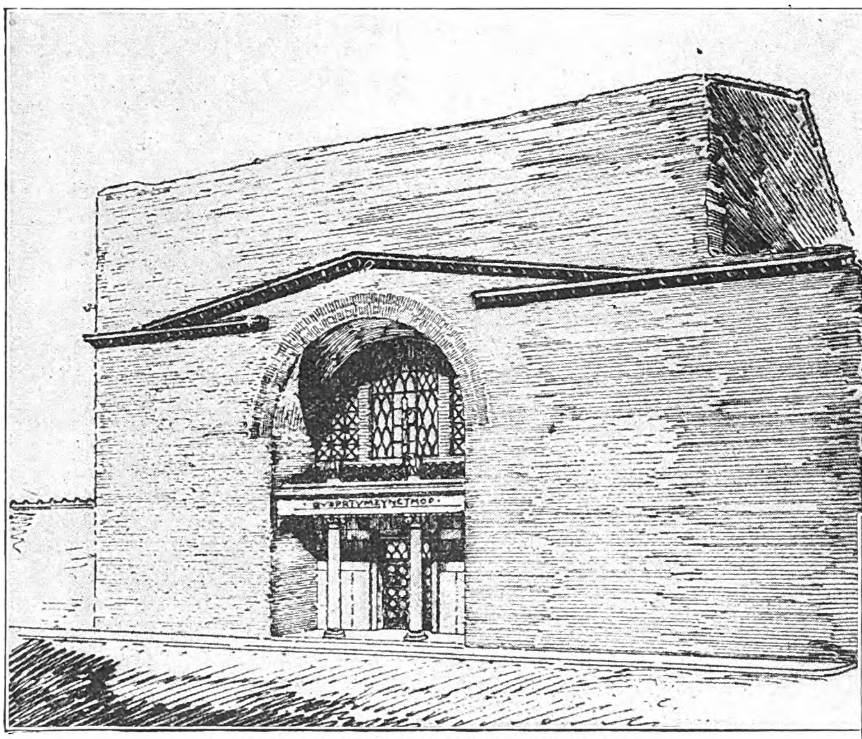


PLANETARIUM IN JENA

It was here that the performance described in the article was witnessed. The dome is of sprayed concrete on a fabricated webbing of iron rods. The outside covering of concrete is thinner, in proportion, than the shell of an egg. Inside of this thin dome a light skeleton supports the acoustic baffle plates shown in another picture, and the linen projection screen



own planetariums. So also do Vienna, Rome, and Moscow. People, old and young, stand nightly in long queues waiting for the performance to begin. It “goes over big.” Within eight months after the first of the new planetariums was installed in Jena, Germany, 78,000 visitors came to have their concepts of the heavens straightened out; 110,000 came in a year. And Jena is a small city. In nearly every case, in Germany, the planetariums are owned by the community. Putting the stars into politics!


THE NEW PLANETARIUM IN ROME

Mussolini decreed that the ancient and modern should be combined, and allotted to the planetarium the Hall of Minerva. A light hemisphere is constructed inside it

That old German city of Jena, once famous as the home of Goethe and Schiller and the philosophers Hegel and Fichte, is now the center of gravity of European optics. Its vast Carl Zeiss optical works is more than a commercial firm, it is a scientific institution. Decades ago its advanced methods of sharing both profits and confidence with its workmen became famous. A day in Jena will be well spent if one has a scientific turn of mind. Much will be learned.

OF course, the planetarium is not a new thing—not in its essence. There have been planetariums since Huyghens first made apparatus for duplicating the motions of the planets. Indeed, an orange revolved around a lamp by a school teacher is a planetarium. But the German invention is so far ahead of anything previously conceived that few, certainly not those who have seen it in operation, will cavil when it is called “the” planetarium.

One enters a large dome. Geometrically it is a hemisphere. An ant would feel the same under the peel of a half orange. The planetarium dome is usually about 75 feet in diameter. If much smaller there are certain optical drawbacks, but if much larger the cost of the structure will be increased out of proportion to its usefulness. A 75-foot dome will seat an audience of 600.

This dome represents the sky, the vault of heaven. Before the lights go out and the heavens are flashed on, one feels as one always feels when in a building—an “inside” kind of a feeling. Shortly, when the lights are dimmed and out and the planetarium spectacle is on, one will acquire an outside feeling—the confining dome retreats to infinity. Thus perfect is the verisimilitude. The dome seems to vanish by magic.

Just about at this time the audience always says “Ah!” You can hear it ripple across the room and back, a genuine kind of an “Ah.” They say that it is an invariable, spontaneous, and insuppressible accompaniment of this first glimpse of the “heavens,” when the stars are flashed on. Even a case-hardened professional astronomer will say it under his breath.

How many stars do you see out of doors on the clearest night? Few who do not already know guess right. Many guess in millions. The actual count of naked-eye stars in a clear sky gives less than 3000. The planetarium heavens have the full quota of naked eye stars. And they look like the stars. How is this perfect illusion brought about? What was it that made the curved dome of the building, nowhere more than a few feet away, suddenly traverse light-years outward in all directions when the lights were turned off and the demonstration started? How would you go about equipping a domed ceiling with 5400 stars—those of two hemispheres—so that they would not seem artificial to the visitor?

A not unnatural conclusion would be, tiny electric lamps attached to the under side of the dome. But at best that would provide only a crude illusion. Then is it holes of various diameters in the dome, all illuminated from behind? Such a method, which has been tried, works better but it lacks just one thing—real illusion. No, the whole 5400 stars are projected from the odd-appearing apparatus in the center of the floor.

HANNOVER’S PLANETARIUM

Atop the offices of the *Hannoverischer Anzeiger*. No doubt that newspaper receives enough valuable publicity from it to justify the initial investment

For a moment let us study the “close-up” illustration this contraption, this giant “dumb bell” with its 119 optical projectors. On either end of it there is a sort of hemisphere, which looks not unlike a diver’s helmet. Within each of these “helmets” is a powerful incandescent lamp. Set into the sides in various positions are 16 lenses. Behind each lens is a kind of diaphragm bearing the right stars in the right places. These project slender invisible pencils of light, corresponding to each star, to the inner walls of the dome of the planetarium. At first glance one might be excused for objecting that the picture shows there are not enough lenses fully to cover the sky. But the concavity of the lenses, as precalculated, takes care of any such discrepancy. Thus there is no overlapping of images, no blurring; nothing is crude, and the illusion is carried out with typical Teutonic thoroughness.

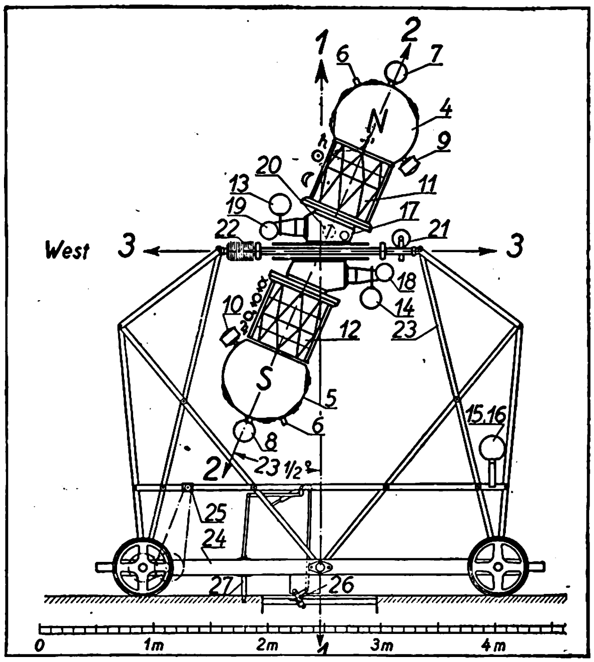
But why must there be two of these "helmets?" one asks. The answer is, to permit the apparatus to project not only the stars of the northern hemisphere but also those of the southern. In the planetarium one travels; indeed, before we have seen the complete performance we shall see things no man has ever seen in reality or ever will see. We shall take the universe to pieces. Some of the effects thus produced are bizarre.

IN addition to the 5400 stars down to the 6.2 magnitude the planetarium projects the Milky Way. This is projected separately from little gadgets on the side of the apparatus. These are shown at 9 and 10 in the longitudinal section drawing.

Now, all these things are not merely projected inertly on the interior of the dome; they move. To accomplish this it is simply a matter of rotating the helmets. A small electric motor does the rotating. This and a number of other motors which operate the various parts of the apparatus is controlled by means of a bank of push buttons on the desk of the speaker. Throughout the hour this speaker, who understands the mechanics of the heavens, explains the phenomena he displays. Thus, as the motor runs, we see the stars rise in the east, culminate and set behind the "distant" western horizon. But the 24-hour astronomical day, which runs off so slowly in the actual heavens that we find it difficult to follow in easy sequence its deliberate events, may here be run off in only four minutes; indeed, if desired, in one minute.

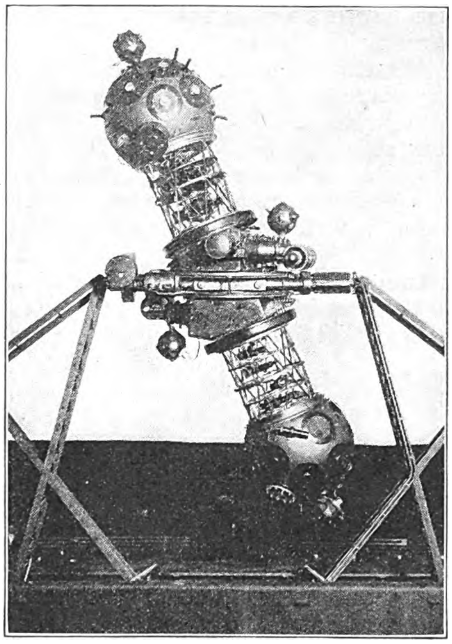
Thus the motions and apparent motions of the heavenly bodies are accelerated and multiplied many fold by this universal mechanism or mechanical universe, and we are able to visualize them clearly, as a whole. It is comparable to those moving pictures, familiar to all, in which an invisible slow happening such as the gradual growth of a root or tendril, is depicted within so short a period that we gain a clear idea of it.

Thus far we have the heavens and they are in motion but, as in Genesis I, 15, our universe is not yet complete—we must add the planets. This brings in some interesting problems of machine design, for you cannot have your planets in motion at the same rate as the stars. Nor is this true of the sun and moon. Each pursues its separate course "through" the fixed stars. Again we have recourse to the photographs of the apparatus and to its section drawing. The planets are in the "handle" parts of the dumb bell. Each "planet" consists of a train of driving gears, especially designed, and now one gradually begins to realize why the apparatus costs so much: it is full of special design; while the lower cost due to mass production is impossible. In each planet there are two pins joined by a connecting rod. Only the earth-sun disk is perpendicular to the long axis. The others are placed at different angles. These correspond to the various angles the respective planets' orbits take with the plane of the ecliptic. This involves another bit of "fussy" design.



LONGITUDINAL SECTION OF PROJECTOR

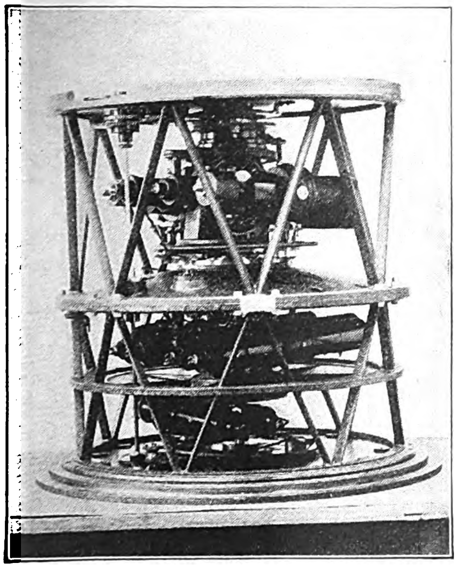
1, polar axis; 2, axis of ecliptic; 3, axis for varying latitude; 4, 5, projectors for 5400 stars; 6, projectors for 18 clusters and nebulae; 7, 8, projectors for 32 constellation names (when desired); 9, 10, Milky Way; 11, sun, moon, Saturn; 12, Mercury, Venus, Mars, Jupiter; 13, 14, ecliptic, celestial equator, poles; 15, 16, meridian; 17, scale of years; 18, diurnal motion motors; 19, annual motion motors; 20, precession motors; 21, motor for 3; 22, contacts for leads to motors; 24, carriage (projector can be moved out of way for other entertainments)



THE PROJECTOR

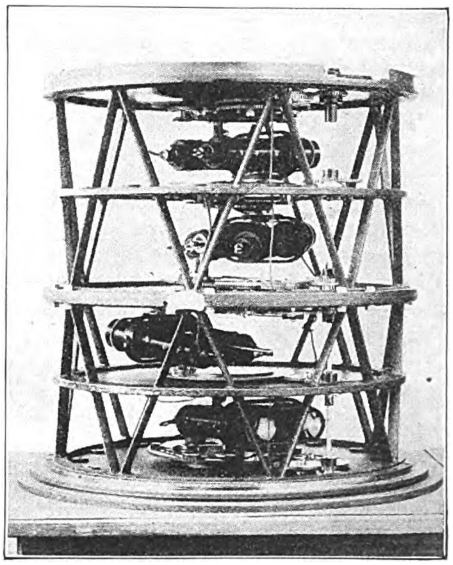
An intricate and beautiful piece of design. Weight 3500 pounds; 119 projectors

To see the outer planets in sensible motion through the stars when the whole heavens are speeded up many thousand times is to understand their motions almost at a glance. This gives



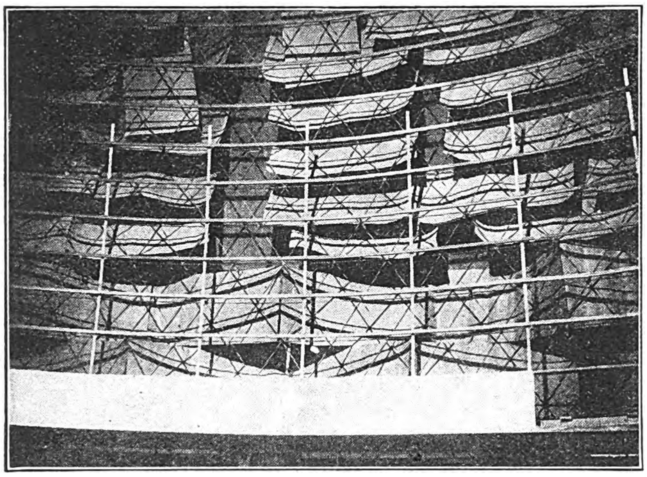
SOLAR SYSTEM PROJECTORS

The sun, its halo, zodiacal light, moon, Saturn—each has its specially geared projector, each requiring a special design



SOLAR SYSTEM PROJECTORS

These, from top to bottom, are for Mercury, Venus, Mars and Jupiter. Note the thin gears set at varying angles



A REMEDY FOR BAD ACOUSTICS

A light interior framework supports irregularly hung pieces of sheet iron. Light linen applied over this forms the spherical projection surface but transmits the sound through

in a few minutes an epitome of a whole year of astronomical events. If a day is made to last four minutes, then Mars is seen to revolve around the sun in 7.2 minutes actual duration; Jupiter creeps along at the rate of 47.2 minutes. Saturn, even then, is barely in sensible motion at the rate of one revolution in 2 hours 56 minutes. Uranus and Neptune are omitted entirely from the projector because they are never visible, anyway, to the naked eye. The inner planet Venus is lively, making the round of her orbit in only 148 seconds, while Mercury whirls round and round in only 58 seconds. If the whole process be quadrupled in speed by pressing another button Mercury now reminds one of a moth, flitting round and round a lamp in only 14 seconds; incidentally throwing light on the derivation of the word "mercurial." There is something ludicrous about the inner planets when thus seen revolving about the sun at a highly accelerated rate. Mercury is a gadfly and even Venus herself is mercurial and lively. The ponderous outer planets are "dignified old parties," not deigning to move with haste even when they are forced to accelerate a few thousand fold.

Thus it gives one a decidedly distinct picture of all the exasperatingly slow motions one sees in the heavens, this planetarium, and a better conception in ten minutes than one could acquire in a lifetime of patient outdoor observing and attempting to remember the continuity through months of elapsed time.

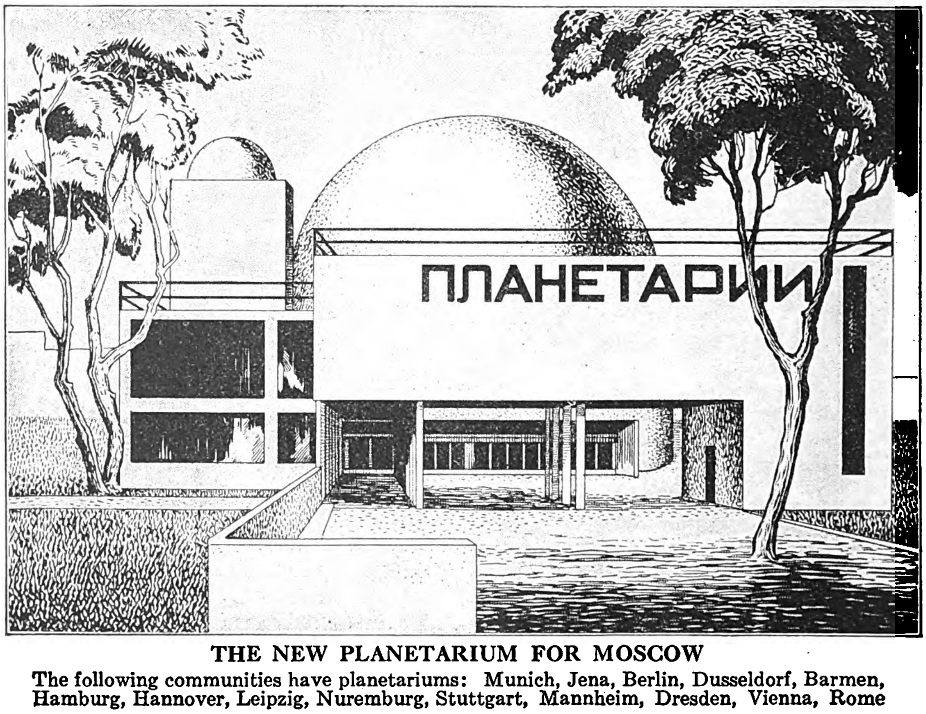
NOW the speaker who conducts the performance will put on some astronomic stunts. He has shown how the heavens look from Chicago or Philadelphia. He wishes to show how they would look from the equator; from Buenos Aires; from, let us say, Commander Byrd's base in Antarctica; and from the North Pole; or from any intervening point. To shift the point of view requires only to press a button, nothing more. A motor (at 21, in the drawing) will rotate the whole apparatus quickly about the horizontal axis which supports it. The axis 1 (in the drawing) must be made to point to the pole of the heavens—be parallel with the earth's axis—wherever we are. Therefore we shift our imaginary latitude or point of view on the earth simply by changing the angle of this axis with the earth's surface.

Now the aspect of the constellations is changed and those of us who are familiar with their outlines are temporarily confused. The stars are no longer in their familiar places. At the equator the Pole Star is on the theoretical horizon but actually is invisible. In Buenos Aires we find the sun and stars rising in the east and setting in the west as at home, yet traversing the northern instead of the southern arch of the heavens. At the poles we are able to see the midnight sun, and at the North Pole we see the Pole Star directly overhead.

We can shift our point of view, in the planetarium, not only in space but also in time. We can easily retrace our steps to the days of the later Cro-Magnon races, 14,000 years ago; or we may jump ahead to see how the skies will look to our descendants several thousand years hence. To accomplish this the little motor at 20 in the drawing, is set in motion. Four minutes of this carries us through 26,000 years, the period of that peculiar gyroscopic motion of the earth which brings about what the astronomer calls the precession of the equinoxes. The earth wobbles, or precesses, as it rotates; much as a top wobbles. Each wobble is in a circle 47 degrees in diameter and requires 26,000 years to complete. This means that the Pole Star is not a permanently fixed reference point. Just now, during our lifetime and during our "epoch," it happens to lie almost in line with the prolongation of the earth's axis. But Vega will be the pole star in 14,000 A. D., and Vega is a long distance from Polaris. At that time the Southern Cross, even now occasionally visible low on the horizon in southern Florida, will be visible from any point in the United States.

ANOTHER bizarre spectacle is eternal night and eternal day, a condition which does not exist in fact, except possibly on the planet Mercury. The rotation of the earth is slowed down until only a single rotation is made in a year. This has the effect of keeping the same face forever turned toward a merciless sun, and the opposite face toward the dark depths of space. With eternal day there would be no sunrise, no sunset. In the planetarium we now see the two inner planets Mercury and Venus revolving around and around the sun, always above the horizon, an impressive spectacle. Or, if we shift to eternal night, we shall see the stars no longer making their familiar rounds about the pole star but about the pole of the ecliptic.

With the planetarium we take the solar system to pieces and see how the pieces work. Superhuman feat! It is the best "movie" I have ever seen.



THE NEW PLANETARIUM FOR MOSCOW

The following communities have planetariums: Munich, Jena, Berlin, Dusseldorf, Barmen, Hamburg, Hannover, Leipzig, Nuremburg, Stuttgart, Mannheim, Dresden, Vienna, Rome

OUR POINT OF VIEW

Charles Francis Brush

DURING the night of June 15, there died in the city of Cleveland, a man with a keen scientific mind and indomitable will power who, at the age of 26, in 1875, developed a dynamo which holds its own even today after 50-odd years of improvement in electrical apparatus; who, in 1879, invented the arc light which won for him world-wide fame, great wealth, the Rumson Medal, and many decorations; and who, during his lifetime, perfected many remarkable inventions and worked out a number of elaborate scientific theories. That man was Charles Francis Brush, outstanding scientist, philanthropist, and humanitarian.

Born in Euclid Township, Cuyahoga County, Ohio, March 17, 1849, young Brush showed great precocity in science. At the age of 13, he constructed his own static machines, electro-magnets, and batteries—these at a time when the practical application of electricity was in its early experimental stage. He was graduated from the University of Michigan at the age of 20 and later achieved a doctor of philosophy degree at Western Reserve University. He received numerous honors from scientific and philosophic societies and from universities.

Few in American history can compare with Mr. Brush, and in many respects he had no peer, for rare is the man possessing the ability and ideals that were his. Active until his fatal illness at 80, he busied himself with scientific problems and humanitarian work. Of the latter, perhaps the best known is his establishing of the Foundation for the Betterment of the Human Race.

No words could exaggerate the worth of this great man, no panegyrics would be too costly in effort; and if this magazine ever establishes a Hall of Fame, one of the very first names to be inscribed there will be: Charles Francis Brush.

Now the Air Country Club

WHILE golf may continue for years to lure sportsmen and tired business men to country clubs, the rapidly increasing interest in aviation points to the inevitable divorce from this sport of many of the more adventurous souls who will, instead, take up flying. Foreseeing this, a group of aviation enthusiasts have organized what is known as Aviation Country Clubs, Inc. The first club to be completed under this plan was recently opened at Hicksville, Long Island, and already plans for over a hundred more are under weigh.

The club at Hicksville spent more than 300,000 dollars in building a club house, landscaping the grounds, and building a hangar and service station. Charles L. Lawrance, of Whirlwind engine fame, is president of the club, men prominent in aviation and in New York business compose its Board of Managers, and many sportsmen pilots —veterans and tyros—will make up its membership; while the lists of National Governors and national members read like a "Who's Who in Aviation."

Such a plan as this had to come. Too many people were becoming keenly alert to the sporting possibilities of aviation for present commercial fields to take care of them. And although to many people the country club connotes so much wealth that they feel their inability ever to belong, there is such a fine spirit of camaraderie among aviators that this idea should not hold in the case of the air country clubs. Sportsmen with a zest for flying should find the hangars of these new clubs open to them without undue formality or payment of unreasonable dues.

Every Ship a Lifeboat

AFTER six weeks of difficult negotiations, the delegates of 18 maritime nations, attending the Conference for Safety of Life at Sea in London, signed a new international sea safety code early in June. The agreement will now have to be ratified by the various nations concerned.

The wisest provision of the code, it seems to us, is that which makes compulsory the carrying of efficient wireless equipment by all vessels of over 1600 tons, except in specific cases such as passenger ships that do not go more than 20 miles from land between consecutive ports or cargo vessels that do not go more than 150 miles from land. All vessels must carry lifeboats; navigation rules are stricter; and internal construction of ships must be modified for greater safety, according to the new code. The United States will continue to operate the ice patrol. Lights and signals for vessels anchored or aground must be provided, and fog signals for 350-foot vessels, towed vessels, or those aground near a ship channel have been changed. Rules for procedure in case of disaster, for stability, for distribution and launching qualities of lifeboats, even for apparently unimportant details of construction, and many other items were included in the code.

The code has a scope much broader than any heretofore drawn up and represents a great forward step in the cause of safety at sea. It will not mean the complete defeat of the hazards of the sea but, with its ratification and the co-operation of the maritime nations, it should be the means of preventing another disaster such as befell the *Vestris*. The delegates to the Conference are to be congratulated on the completeness with which they accomplished their difficult task.

Clothes Make the Man—Hot!

THIS summer, women's clothes have been conspicuous by their absence. Décolleté street dresses have been very much in evidence, bare arms have "flourished" as never before, and sox and bare legs have become so common, in certain metropolitan sections at least, as to cause not even a traffic hold-up. As for the scantiness of other things, comment is unnecessary.

Children's clothing, too, has been of the simplest kind. The younger children especially have enjoyed the summer and remained cool in suits amounting to nothing more than trunks and a bib.

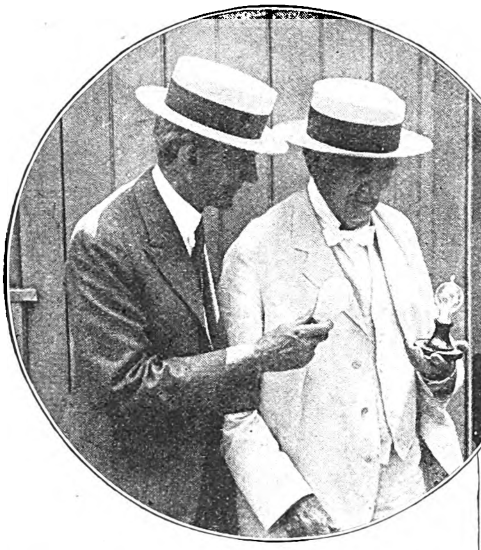
But how the men have sweltered! And how we've wished for simpler, cooler garb! Our women-folk say we must be conventional—we must dress as usual, even to a waistcoat, in the warmest weather—and the tailors say they won't let us throw off our excess poundage of clothing since it would ruin them. We've sworn we'd break away some day, damn convention and the tailors, and dress for comfort. Such outbursts, however, are mere bravado. We simply haven't the individual initiative, due most likely to our decreased efficiency which is due, in turn, to our eight or ten pounds of clothes; and, collectively, we seem unable to function.

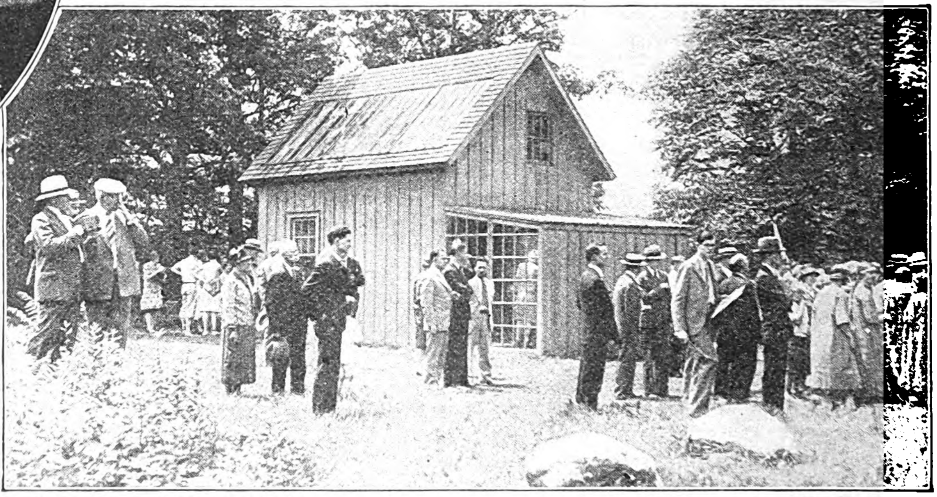
Fortunately, there has recently been much more agitation for radical reforms in men's clothing than ever before. Will we forget it all with the coming of cooler weather this fall? We will not! There must be a concerted effort before we can overcome the apathy of old-fashioned dressers and the inertia of those invertebrates who would rather let someone else take the initiative. A lot of proselytizing is necessary, but we simply must have our comfort.

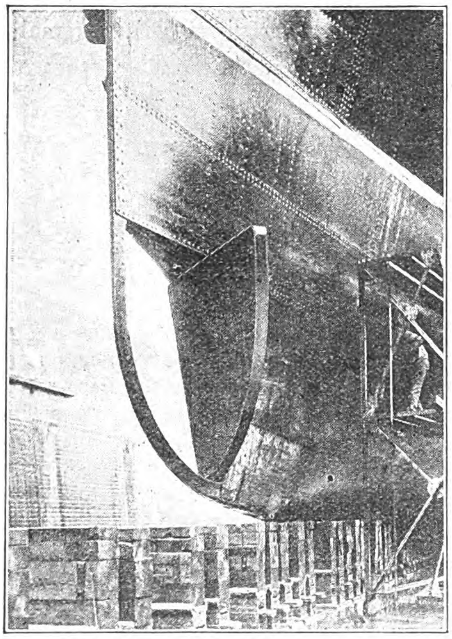
From the Scrap-Book of Science

EDISON'S FIRST LAMP FACTORY PRESENTED TO MR. FORD

Fifty years ago Thomas A. Edison invented the incandescent lamp in the factory shown below. On June 22, 1929, Mr. Edison presented this shack to Mr. Ford and it is to be dismantled, shipped, and re-erected at Dearborn as part of the Edison Institute founded by Ford. At left are Mr. Edison and Mr. Ford holding the original and a new lamp





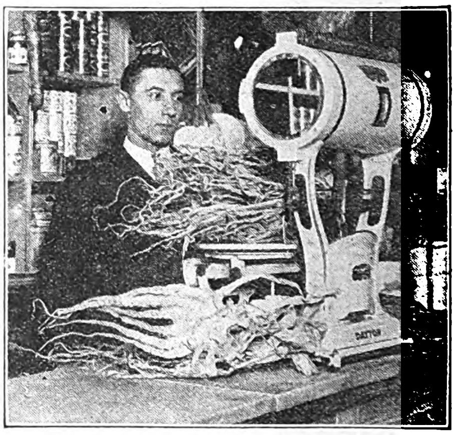


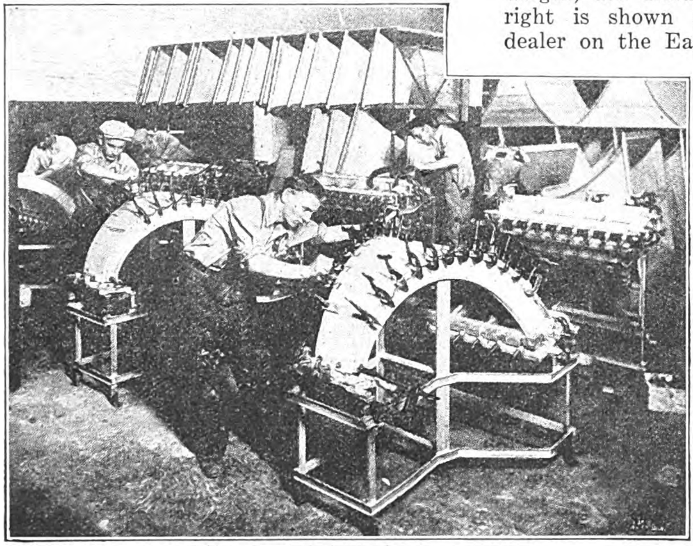
◄ BOW RUDDER

To facilitate control of the vessel in narrow channels of the Pacific coast, the *Princess Norah*, latest acquisition of the British Coastal Steamships of the Canadian Pacific Railway, was equipped with a bow rudder, as shown in this photograph of the new ship

QUEER FOOD ►

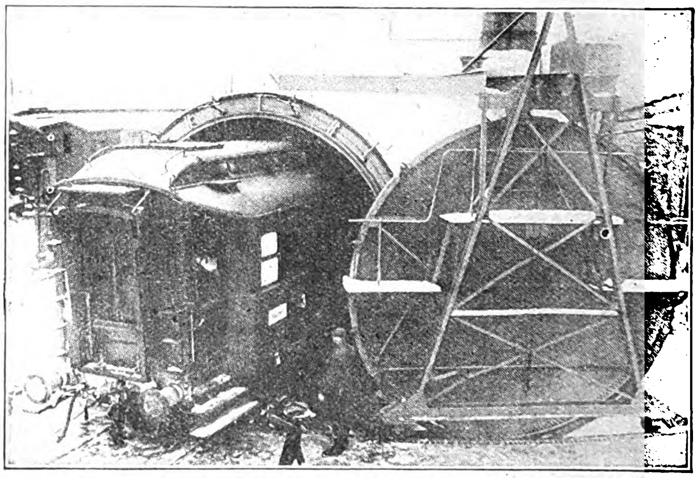
Spaniards and Italians in the larger cities of the world eat with relish baby octopuses which come from the waters off Algiers and Spain. They are caught when under five pounds in weight, are dried, and shipped. At right is shown a Spanish octopus dealer on the East Side, New York





APPARATUS FOR "TALKIE" FILM

The horn is one of the most important factors in the new art of sound pictures. The photograph shows workmen gluing "orthophonic" horns for sound picture reproduction. The work requires highly developed craftsmanship as the eveness of the curve in the horn structure is of utmost importance for tonal quality. The scene above is from the Western Electric Company's plant, Chicago

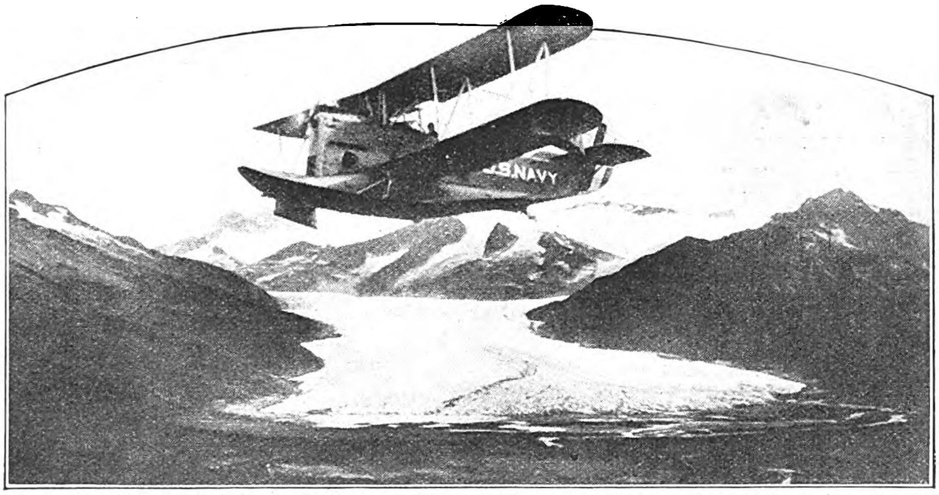


EXIT BUGS AND GERMS

After each 35,000 miles of service, every car on the German National Railway is sent to a shop in Potsdam for complete inspection, disinfection, and overhauling. The car is rolled into a cylindrical tank which is then hermetically sealed and filled with disinfectant. The chemical does its work, and the car is then removed for overhauling. The photograph shows a car being placed in the tank

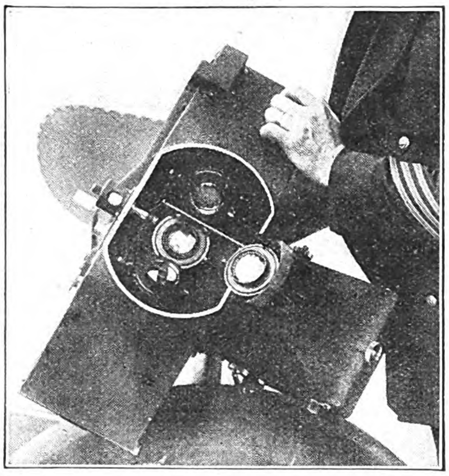
NO MORE FALSE ALARMS

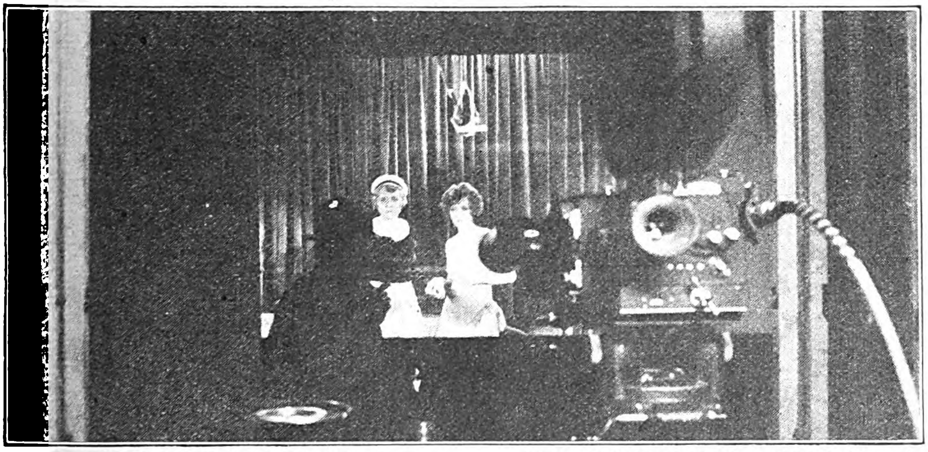
When fire alarm boxes are equipped with this device, jokers and false alarm "bugs" will have the joke turned on them. The alarm will be turned in, but the device will also photograph the person who turns it in. If the alarm is false, the photograph will serve as a clue to the joker



ALASKA IS MAPPED

Recently the United States Navy's second aerial mapping expedition to Alaska left San Diego, California, to finish the work started four years ago. The new expedition will map from the air Chicakof and Baranof Islands, probably basing at Sitka and working north from Christian Sound on Baranof to Icy Strait on the northern tip of Chicakof. Above is shown one of the navy planes over Mendenhall Glacier, and at the right is the camera to be used, showing four lenses



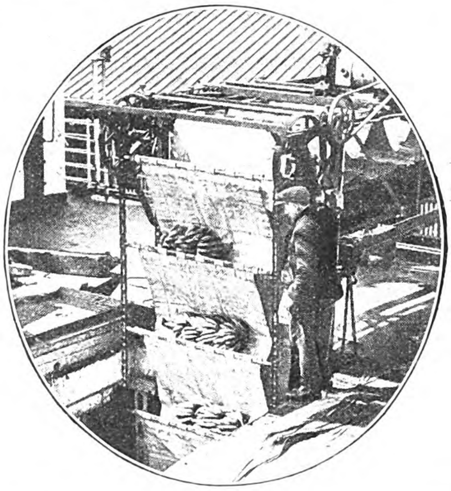


SOUND-PROOF CAGE

In making sound pictures, it is important that no sound from the camera shall reach the "mike." Such pictures are "shot" from within a cage through a glass window as shown in this view taken through cage door

YES, NO BROKEN BANANAS ➤

Much faster and far more efficient than the hand method of unloading bananas from ships, this electric elevator was recently placed in operation on the docks in London, England. It consists of canvas swung between the chains of an endless conveyor

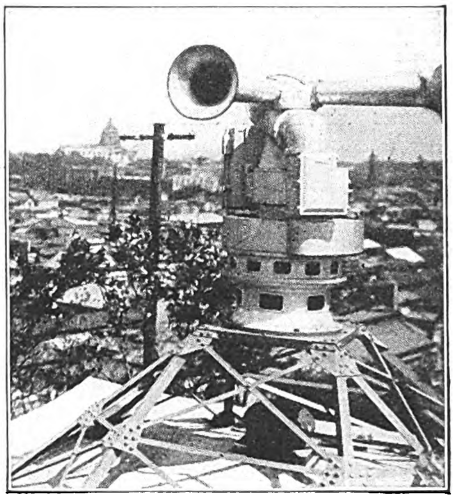


◄ SMELLER BY PROFESSION

This is no joke nor is the man paying an election bet by attempting to emulate the elephant; his is one of the world's strangest professions: that of gas-smeller. A number of these experts go about Berlin, stick long tubes in the ground, and sniff. When they detect the odor of escaping gas, they call the gas company's repairmen

SCREECHING THE TIME ➤

In Tokio, the hours of the day used to be signaled by the firing of a cannon at a nearby army post. The practice has now been discontinued by imperial order and this large fire siren signals the time from the top of a building



Licorice the Versatile

This Age-old Sweetmeat, Medicine, and Sacred Herb Links the Modern World With Ancient Peoples and Religion

THE history of licorice is as old as the history of medicine itself. It is replete with folklore and tales of religious and occult uses. As that eminent pharmacologist and author of "Etidorpha" and "Stringtown on the Pike," Dr. John Uri Lloyd, has so aptly said, "Licorice has always been used to such a great extent that it is very generally assumed that everybody knows all about it, and hence very little has been written concerning it." It will probably surprise many of our readers to know that it has other uses than in medicine and confectionery.

In childhood days most of us have chewed licorice root. The slender sweet sticks were sold for a penny a piece. Most of us have also bought attractive licorice candy, such as "shoe laces," "nigger babies," and in other fascinating forms. It is a curious fact that licorice candy need not be black at all, for while the normal color of pure licorice is a brownish-black, that of some licorice candy is like mocha, from the blending of a small proportion of the dark brown licorice with white sugar. Later on in life doctors have prescribed licorice to ease our coughs and sore throats and as other aids to health. After we are grown up many of us have met licorice as a flavoring material in tobacco. It was probably not apparent in pipe and cigarette tobaccos, but would be recognized in chewing tobacco, of which it is an important ingredient.

All photos courtesy MacAndrews and Forbes Company

UNLOADING LICORICE ROOT IN THE EAST

From hundreds of points the licorice root is brought to the sea coast by means of every imaginable kind of conveyance

THERE is real romance connected with licorice, which reaches back into the earliest recorded history and beyond. It was known and grown in that region of Mesopotamia which is regarded as the cradle of civilization. The famous Egyptian alchemists and learned Greek physicians knew its worth. During the dark ages thousands of tons were consumed in all parts of Europe. The root was usually gathered in the fields of Arabia. The ruins of the alleged Tower of Babel arise from the center of the licorice belt, in a section which produces large quantities of the root. Theophrastus, who is called the "Father of Botany," and who was the pupil and friend of Aristotle, wrote three centuries before Christ — "Scythian root (licorice) is also sweet; some, in fact, call it simply 'sweet root.' It is useful against asthma or dry cough and in general troubles of the chest, and is also administered in honey for wounds. It has the property of quenching thirst, if one holds it in the mouth; wherefore they say that the Scythians, with this and mare's-milk-cheese, can go for eleven or twelve days without drinking."

Few of us have thought of licorice being used in warfare, and yet, aside from its use in treating wounds, we can see where it was a real advantage to the armies of these ferocious, warlike peoples in aiding them to make long forced marches without water.

Archeologists have discovered in the neighborhood of Ctesiphon on the river Tigris, near Bagdad, some remarkable tablets. As early as seven centuries before Christ they describe the use of licorice by physicians in treating their royal masters. The Indian Prophet Brahma recommended it to his people as a general tonic, beautifying agent, and elixir of life. The Chinese also made a regular practice of eating licorice. In fact, they still use it in large quantities thinking it keeps their bodies supple and increases their endurance and enables them to ward off old age—a large order! Down through the Middle Ages the use of licorice increased steadily, and during the Renaissance it became very popular as "sweet medicine."

During the reign of Queen Elizabeth, licorice root was grown in England in the neighborhood of the proud historic Pontefract Castle. A quaint English couplet of the thirteenth century indicates that licorice had become almost synonymous with sweetness:

"His love al so sweete, y-wis
So ever as milk or licorise."

Chaucer himself wrote:

"But first he cheweth greyn and licorys
To smellen sweete."

AS recently as 1900 a well known English physician, Dr. George S. Keith, wrote of the medical aspect of licorice as a curative agent: "Licorice has some most useful properties. For relieving the symptoms caused by acrid matters in the stomach, I know nothing to equal it, and I have used it for this purpose for at least 40 years. It certainly relieves, often in a very remarkable way, the innumerable pains and discomforts, mental and bodily, which arise from irritation of the gastric nerves, as local pain of stomach or bowels, headache, sleeplessness, lowness of spirit, or irritability and general misery. I have known relief from licorice in a very large number of cases both of dyspepsia and sleeplessness."

About one hundred years ago there penetrated into the ancient lands of the Near East an adventurous pioneer of industry bent upon the commercial utilization of licorice root. He took with him those servants of industry—the engineer and the chemist—a very wonderful thing for the time. The chemist found in licorice a wonderful new substance about 50 times as sweet as sugar—a substance found no where else in nature. This material was given the impressive name of "Glycyrrhizin" (which means no more than "sweet root"), and it is to this top-heavily named substance that licorice is indebted for its value as a flavoring and sweetening agent. In time the wholesomeness of licorice confectionery became recognized, especially in Europe where a large variety of licorice candy finds a wide and ever increasing sale.

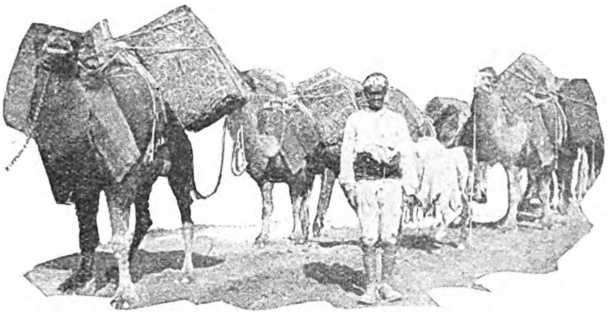
As time went by the business of this pioneer increased so that it was necessary to have a fleet of steamers to transport the licorice root from Spain, Italy, Greece, Asia Minor, Russia, Persia, and China to the United States where the roots from the various sources were skilfully blended, just as is done with fine coffees and teas, and the extract, known as "paste," was supplied to the tobacco, pharmaceutical, and confectionery trades. We will describe some of the rarer but none the less useful qualities of licorice a little farther on.

Large quantities of licorice are gathered every year, the total sometimes exceeding one hundred million pounds. If we could visit southern Europe and the Near East during the licorice harvest, we would see many strange sights. Thousands of peasants from Madrid to Bagdad, and from the banks of the Volga to the banks of the Nile, would be seen digging the root and carrying it in bundles on their heads and backs, or transporting it on the backs of donkeys and bullocks, or in carts, or on the backs of the patient camel. Spain, Italy, and Greece furnish a goodly share of the supply of the licorice root. The Jordan Valley, the Holy Land, the birth place of Christianity, and the fertile valley of the Tigris, all contribute their quota. The picturesque peasants who gather the root are a motley crew of Chinese, Jews, Arabs, Armenians, Turks, Russians, and Tartars, and the primitive picks which were used probably date back to the time of Abraham.

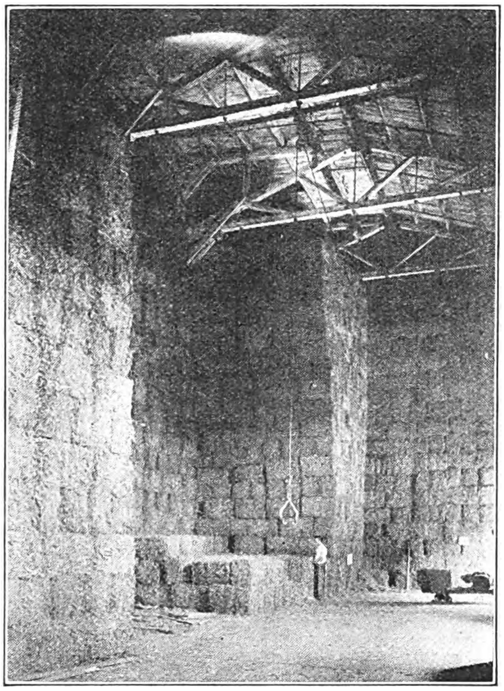
THE roots are carried to a baling station where they are inspected, weighed, and paid for. The roots are piled in huge stacks for curing, which occupies the entire winter, before the roots are dry enough for baling. The stacks of roots are protected during the rainy season to prevent mildew. When thoroughly dry the roots are pressed by hydraulic presses into bales weighing about 300 pounds and secured by wire or strap iron.

The transportation of these bales to seaports offers a big problem which has been solved by the natives in many ways. At various stations in the interior of Syria, Armenians and Bedouins are hired to transport the bales. The heads of the stations frequently advance considerable sums of money to buy camels and never seem to have their confidence misplaced. Should the collecting station be located on a river the licorice is transported in crude crafts, barges, and sailboats. Having been brought along side the steamer, the bales are hoisted on board and transported to the United States where they are piled in huge warehouses until the raw material is needed.

A BULKY LOAD
This Tartar porter in South Russia is carrying licorice root to the baling press



AN IMPORTANT LINK IN TRANSPORTATION
Much of the licorice root of commerce is brought down by camels to navigable rivers and the sea coast



A LICORICE WAREHOUSE
One of twelve huge licorice warehouses at Camden, New Jersey, safeguarding thousands of bales of dried licorice root

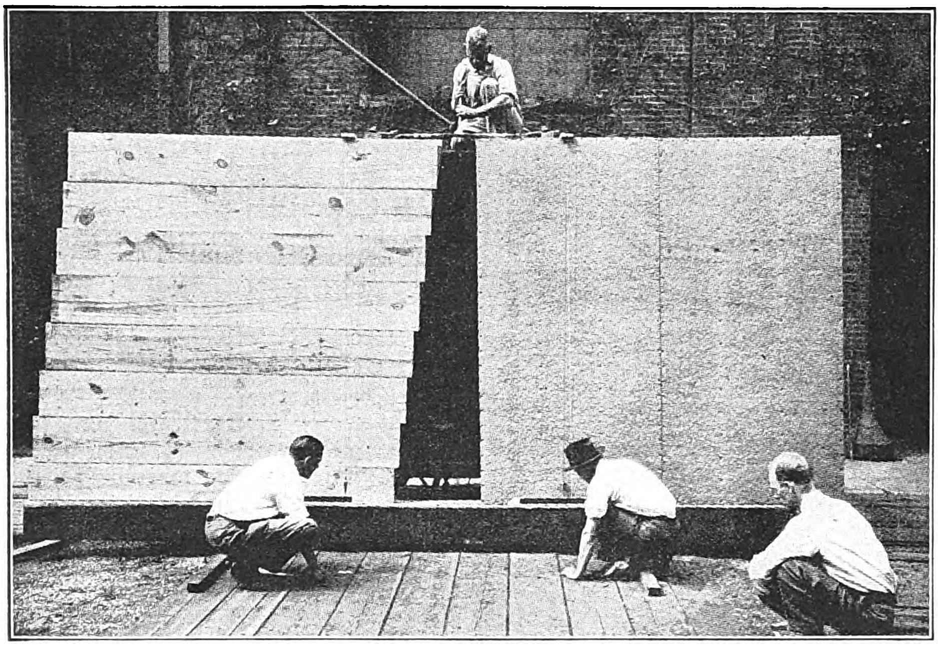
The process of manufacture is as follows: The roots, after going through what is known as a "bale breaker," are passed through a "shredding" machine where the tough fibers are reduced to a coarse mass. Part of this root mass is ground to a fine powder which is then sifted through a fine mesh and ground like flour. This powdered licorice root is of great use in pharmacy where it is used as an excipient and as a dusting powder. The remainder of the shredded root is carried by moving belts to the batteries of extractors where the active principle of the licorice is extracted, the process being chemically controlled; that is to say, samples are taken at regular intervals and tested. When the extraction is completed the solution is treated in various ways according to the uses to which the final product is to be put.

The solution is then "settled" in tanks and pumped to vacuum evaporators where the water is driven off while the solution is under extremely low pressure. In the ordinary method the solution was evaporated in open kettles, but oxidation due to exposure to the air is apt to take place. Care is taken to prevent "foaming" of the solution. The solution has now become very much concentrated and goes to drum driers, or what are known as "finishers." In the drum driers the solution comes in contact with an internally heated metallic cylinder. The solution which adheres to the drum is evaporated and carried to the scrapers during a partial revolution, and the material is scraped off and falls on to a conveyor.

THE dry extract is then powdered and screened and is sold in commerce under the name of "powdered licorice extract." The licorice "syrup" as well as the licorice "paste" are the forms which interest the confectioner. The "paste" is obtained by treatment of the solution in the "finishers" where it is steam heated in copper evaporating kettles fitted with internal revolving scrapers which keep the thick paste from adhering to the kettle. The paste is drawn from the finishers and is weighed into paper lined wooden cases or cartons. It gradually hardens into a dark brown semi-plastic mass which is easily fractured by a smart blow.

In the past, the use of real licorice as a flavor in confections has been limited by two factors: first, the difficulty and cost of handling the licorice mass and second, the continual association of the anise flavor and the black color with "licorice" candies. The first of these has been eliminated by the introduction of soluble confectioner's licorice. The removal of the second should follow, for such a tradition is a handicap to the confectionary industry. The National Confectioners' Association is educating the people to realize that candy is not only a food but a health food. The health advantages of licorice are apparent.

A curious and minor use for licorice is to make a solution which is found to



THE END OF THE ROOT

All the goodness having been extracted from the root, the fiber which remains is made into a useful board which has great strength. Here we have a distortion test of "Maftex"

be excellent in etching steel sections in the preparation of photo-micrographs.

We now have the licorice in the form for pharmaceutical use and for the confectionery and tobacco trade, but abroad they use licorice in other ways. Throughout southern Europe non-alcoholic beverages made from water infusions of either licorice root or licorice paste have been very popular for generations. The value of licorice as a tonic and "blood purifier" has long been recognized, and large amounts of licorice beverages are drunk by the people during the spring and summer months. In most of the factories of France, and especially in the iron and steel mills, it is given to workers for drinking purposes instead of plain water, for it has been found that they are thus better enabled to stand the intense heat.

In Egypt hundreds of tons of licorice root are still used each year in making a drink known as "*mai sus*" (licorice water) which is an infusion of the root in cold water. It is a favorite drink among all classes at social gatherings and weddings, where handfuls of the milled root are thrown into large earthenware jars of drinking water. In Turkey, the well-known vendor of licorice water and sherbets with a brass urn on his back, is a noticeable and picturesque figure.

IN business, the modern dragon of expense is called "waste." What should be done with the root from which the active principle has been extracted? We all know the old story of the complete utilization of the pig, but here even the squeal has been commercialized, for a remarkable property of licorice was found to be that it possessed the property of foaming strongly. Brewers, when brewing was good, were in the habit of putting licorice in beer for giving it a "head."

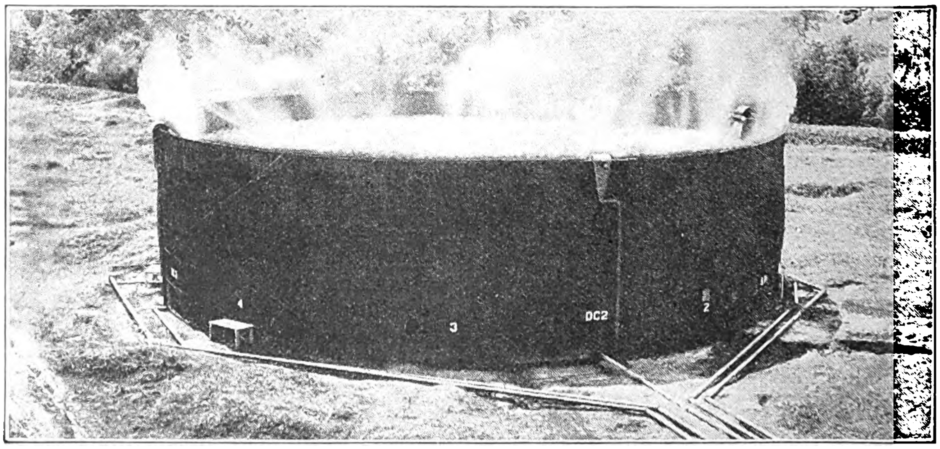
A stroke of genius applied this foaming property to the development of a revolutionary method of extinguishing fires. This method is based on the simple principle that fire immediately ceases to burn when the air supply is cut off by a layer of oxygen-free foam. First of all the licorice root is boiled with water to make the required extract for pharmaceutical and tobacco manufacture and the licorice syrup for the confectionery trade, as we have seen. Then the so called "spent" root is given a second extraction which yields a liquid of extraordinary foaming power. The Foamite system of fire extinguishing has resulted in great property savings.

It would really seem as though the poor root might now end its days in peace, but not so. The ultra-efficient manufacturer said, "Find me some use for the tough fiber of this spent root which we are now burning under the boilers simply to get rid of it." Laboratories were consulted and engineers made experiments, and in a short time a large paper mill was engaged in turning what was left of the licorice fiber into valuable commodities, such as wall board and box board.

It is a far cry from the plains of Damascus to the cardboard box in which a specialty shop may deliver milady's gown. Other fiber boards were developed and proved in many cases superior to those hitherto available. A notable example is the manufacture of "Jacquard cards," which are used in the weaving of tapestry and other figured materials. Holes punched in the cards control the woven design. Therefore, the cards must possess great rigidity and strength. Jacquard cards made from licorice fiber have won recognition as the best for this particular application.

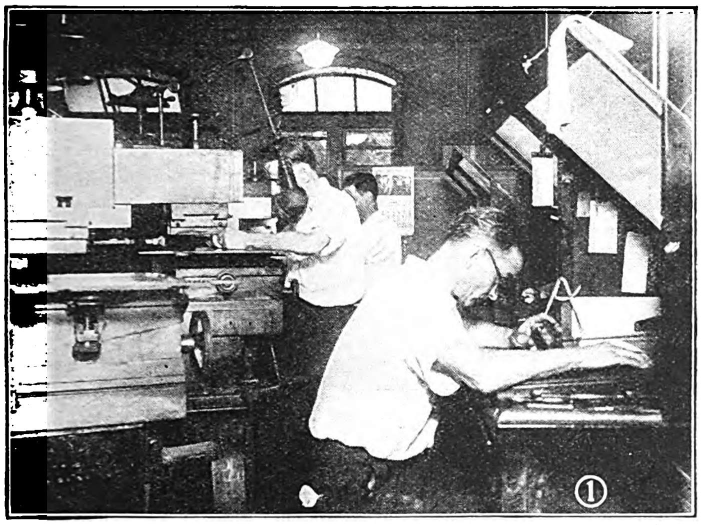
Still the engineer, the physicist, and the chemist were patiently searching and testing. It was found that the licorice fiber had other extraordinary properties besides strength. It proved to be a remarkable insulator. Heat and sound were unable to get through it. Thus the way was opened for another addition to the long list of licorice products—an insulating board which has enjoyed immediate acceptance as a phenomenal new structural material for the architect and builder, for factory construction, and for the home.

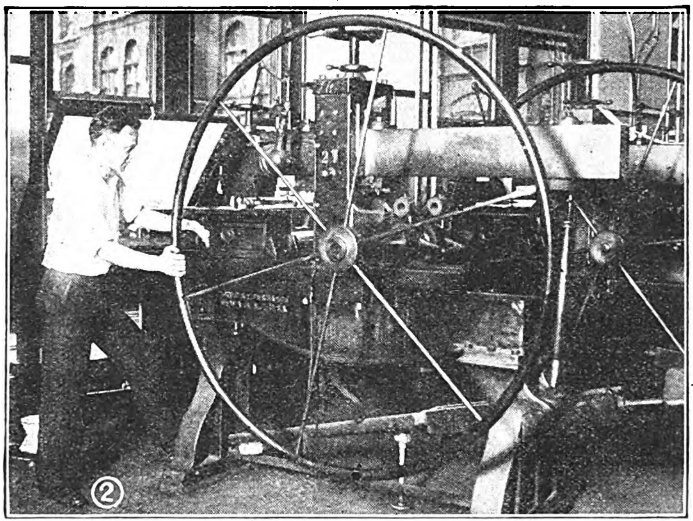
IMAGINE a tough fiber-board 8 feet long, 4 feet wide, and about ½ inch thick, superior to lumber for sheathing; a board with an ideal surface for receiving plaster; a board which prevents the passage of heat, cold and noise more effectively than a six-inch wall of brick, stone, or concrete; a board which gives the American citizen a more comfortable home for less money. The last vestige of the root has been utilized. The story of licorice in the service of mankind is ended.



A LICORICE DERIVATIVE GETS TO WORK

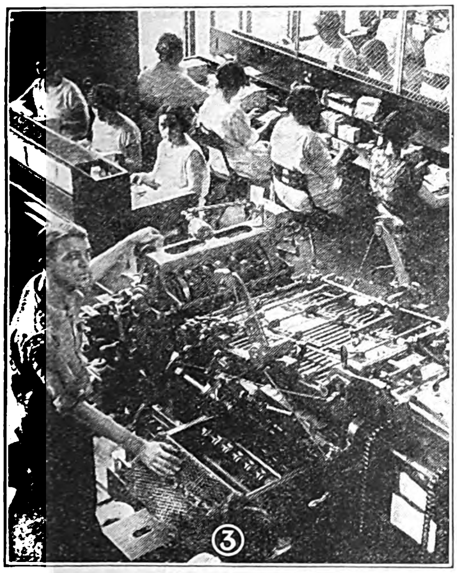
Here is a product of the "spent" root. The second extraction gives a liquid of extraordinary foaming power. This is the basis of the "Foamite-Firefoam" method of extinguishing fires



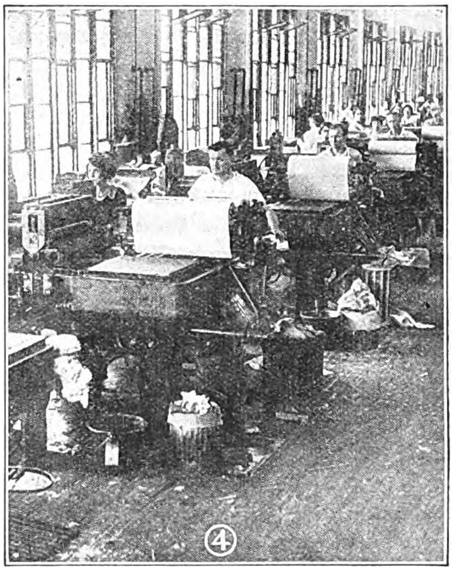


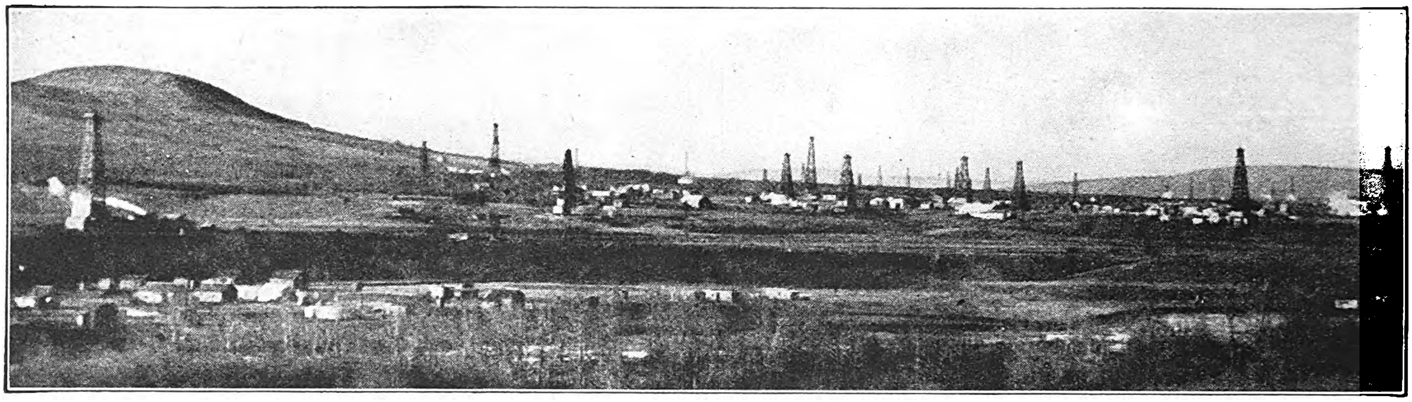
Uncle Sam Gives Us New Money

THE new currency which was issued in July by the United States Government certainly has many things in its favor. The new bills are smaller, and are therefore easier to fold and handle. They are also "sized" with a new preparation which protects them from grease and dust better than the old bills. The paper is improved both in strength and folding quality. The portraits on each note indicate the denomination. Washington appears on the one dollar bill; Jefferson on the two; Lincoln on the five; Hamilton on the ten; et cetera, until we reach the $10,000 bill adorned by a picture of Salmon P. Chase. The government will save large sums by the new money. It is hoped that the stepchild, the two dollar bill, may be restored to respectable billdom with its aggressive numeral.



THE production of the new money follows the same process as the old. The design having been decided upon, parts of it are assigned to specialized engravers who each engrave a part (1) on a small piece of annealed steel. After being inspected and passed, it is hardened. A reversed duplicate is made by rolling a soft steel cylinder upon it in the transfer press, (2). This gives a relief steel die which is hardened and in turn serves to impress an intaglio or recessed design, on a soft steel plate which is hardened for use. The steel-plate presses are of special design (3) and the paper is wetted before use. The printed bills are then sized and dried, but they do not become "money" until they are numbered (4) and the treasury seal affixed. The inspection (5) is rigid and then the bills are wrapped in packages (6) and they are ready for their journey to the ultimate user. The old money will soon be displaced.





THE TURNER VALLEY OIL FIELD IN CANADA

One of the most important developments in the oil industry has taken place during the past year in the Turner Valley, which is now producing oil at the rate of more than 1,000,000 barrels a year, and billions of cubic feet of gas containing high-grade naphtha

Why Does An Oil Gusher Gush?

An Understanding of the Importance of Natural Gas Replaces Misconceptions About "Oil Pools" and "Rock Pressure"

By ARTHUR P. WOOLLACOTT, F.R.G.S.

FOR the past two hundred years the United States has been riding the top-most crest of a wave of prosperity, which has made her the envy of the world. A virgin country with apparently inexhaustible resources when the Pilgrim Fathers landed, her swarming millions have since used up a considerable proportion of those reserves, piling up immense fortunes in the process.

The matter-of-fact economist now and then reminds the exploiters that you cannot eat your cake and have it too, but the significance of his language is not easily understood, and when understood is very seldom heeded. When the economist says that certain resources like minerals and oil are exhaustible and when once used are gone forever, most people will agree with him. They have agreed with him to the extent of believing that reforestation has become a necessity if we want any more timber. But when the "Go Slow!" sign is put up in the oil industry there is a tendency even among oil men to smile knowingly, and increase production, for if our oil is to become exhausted by 1950 as the United States Geological Survey asserts it will, why should oil men, who may be dead before that day arrives, worry in the meantime? You can't persuade the cheerful attendant at the filling station that he may eventually lose his job because there will be no more "gas" to sell; it is unthinkable.

However, no less a person than former Secretary of the Interior Hubert Work, having in mind the prediction of the United States Geological Survey, sent premonitory tremors of economic terror into the hearts of a few when he pictured what would be the effect of the exhaustion of our petroleum supply.

It would be a catastrophe second only to the World War; without oil a modern war could not be waged; millions of automobiles would halt; marine transportation would be radically affected, aviation would be paralyzed, and numerous other inconveniences would follow, not the least of which would be the necessity on the part of the United States to buy oil elsewhere to the tune of more than a billion dollars a year.

SO today we have methods of conservation in operation which are of greatest importance to the public, since their tendency is to prolong the life of oil production, and thus make it possible to continue the national joy-ride until science comes to the rescue with some other cheap source of power when the fields are at last exhausted, as they certainly will be sooner or later.

One's first thought on looking at a "gasser" spouting its millions of cubic feet of gas into the air every day, or a "gusher" throwing up its thousands of barrels of oil, is, "How long will it last?" Wells have been known to emit a steady stream of gas for twenty years or more, while producing oil wells have been flowing steadily for half a century. On the other hand, we have wells that have come in before lunch with a force and volume sufficient to justify the owners in thinking that they were at last in the millionaire class, only to sputter and die down to a feeble oozing from the casing-head before night.

Why the difference? Once upon a time it was thought that oil was forced up from below by what was called "rock pressure," the assumption in the mind of the reader being that the enormous weight of the rock above the oil "pool" forced up the gas or oil in that great spurt known as a "gasser" or a "gusher" as the case might be. But if by "pool" is meant a lake of oil, and by "rock-pressure" the weight above, then the terms are misleading for oil does not exist in pools, nor is it forced up to the surface by the weight of the earth's crust.

Both gas and oil are found in the permeable sandstones and limestones only when these strata are in between layers of harder and more impermeable rocks, like shales, which prevent the upward and downward escape of these products. But both gas and oil are forced through a stratum by the flushing action of water and by gas expansion, often many hundreds of miles under the basement of the plains, unless caught and held in a favorable "structure," that is to say, in the arch of a roll or fold in the strata.

Gas is regarded as a distillation product of oil, and may be either "wet" or "dry." The former produces high-grade naphtha in varying amounts according to its "wetness." The Canadian well Okalta No. 1 in the Turner Valley field in Alberta recently blew in with a production of 32,000,000 cubic feet of exceedingly wet gas a day, which upon extraction yields 1000 barrels of 72° Baumé naphtha a day worth about $4.26½ a barrel. Other gas wells produce a dry product useful for industrial purposes, but containing no gasoline in sufficient quantity to warrant extraction.

One can understand a wet or dry gas coming to the surface because it is of the nature of gases to expand and escape, but what brings up the heavier oils?

It is now generally recognized that the presence of gas dissolved in the oil is the chief factor in causing oil to move into a well and out of it again. In other words the so-called "rock-pressure" is nothing else than gas-pressure. If there is no gas present in the oil, there is no pressure, and no flow into the well. From this it will be apparent that there is necessarily a "gas-oil ratio," that is to say, the number of cubic feet of gas required to move a barrel of oil out of a well. Gas-oil ratios vary from 3000 cubic feet per barrel of oil, to 20,000 cubic feet in wells that are not controlled by "back-pressuring." The difference in expenditure of gas-energy, it will be observed, is very great. Some wells require as much as seven times more force to lift a barrel of oil to the surface than others.

It will be realized also that there exists for every well at any time in its history an economical gas-oil ratio, which will give the greatest oil flow with the least expenditure of gas. This ratio must be found by experimenting with back-pressuring, a term that is best illustrated by the familiar trick of placing a finger over the nozzle of a hose. The more you stop up the opening the greater the back-pressure. In the case of an oil well this is done by placing a metal pressure "bean," which may be from one to two or three inches in diameter, in the orifice of the escape pipe. This method enables a smaller amount of gas to lift up a larger amount of oil and so tends towards economy.

The entire contents of a well, when the oil or gas horizon is tapped by a drill hole, are forced out as rapidly as the size of the bore-hole will allow. This is true so far as the gas is concerned, and true of the oil also to the extent of its associated gas. The escaping gas, however, does not carry along with it all the oil. In fact only a small proportion of the oil in any field is ever recovered. Once the gas in that field is exhausted, no further oil can be obtained except by the slow process of pumping, and if there is not sufficient gas left in the strata to drive the remaining oil into the well, even pumping will not bring up what has not reached the well.

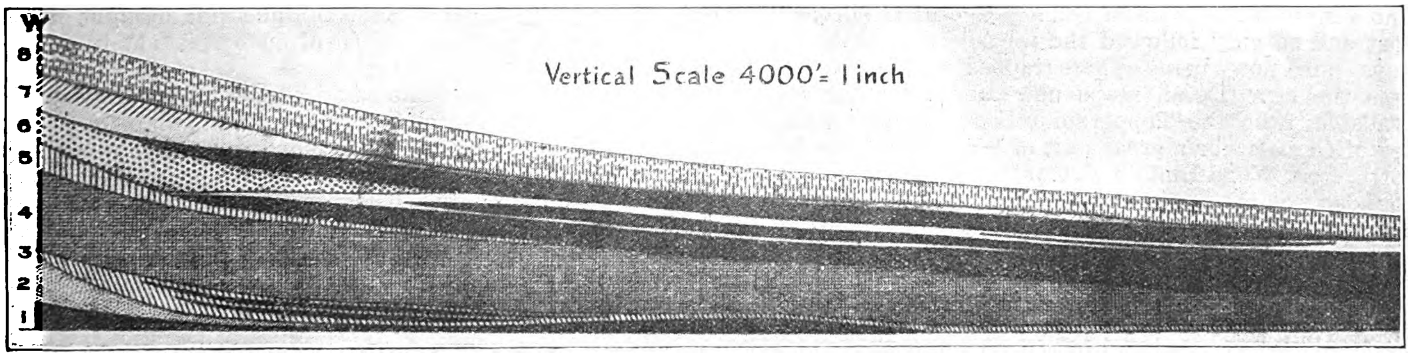
FROM all of which it is clear that gas conservation in an oil-field is the primary concern of the prudent operator. The Canadian fields, profiting by the lesson of the terrific waste in other fields, are conserving their gas, forcing the surplus under 750 pounds pressure back into the exhausted Bow Island sands. This huge underground natural gasometer, south of Medicine Hat, will ultimately hold twenty billion cubic feet of gas in storage for any purpose for which it may be required.

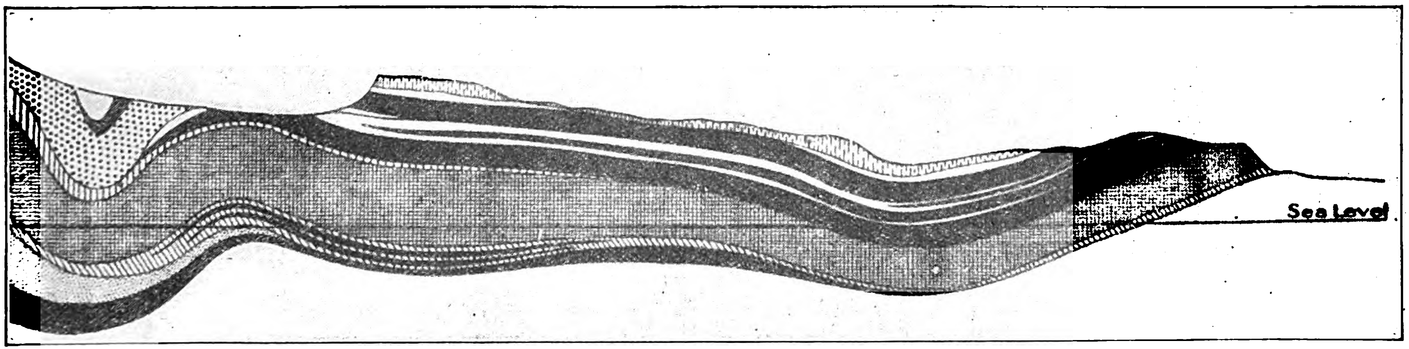
Although the southern California operators are now swinging into a high rate of production that seems destined to react unfavorably on the industry before the end of the year, many operators in the Long Beach and Santa Fe fields have indicated their willingness to help the state conserve its natural gas. During a recent month the gas held in the ground amounted to 146,782,000 cubic feet a day. Of the 918,199,000 cubic feet of gas produced in these fields daily, there were 350,346,000 cubic feet used in the field; 310,971,000 sold to consumers, 217,300,000 lost, principally through new wells "blowing off," and 11,433,000 cubic feet injected back into the ground for "back pressuring."

It is well known among oil men that with ordinary flowing and pumping methods, a comparatively small part of the original oil content of the sands is ever brought up, while with efficient control of gas production and pressure, together with proper well spacing, it is estimated that the recoverable percentage will be doubled. Fields already depleted of gas may be rejuvenated by gas injection on a large scale.

Gas injection under pressure into an exhausted field is now practised for three distinct purposes—to raise and maintain a pressure that will result in further recovery of oil; to store surplus gas for future use; and to circulate dry gas as an absorbent agent through unrecoverable oils in order to extract from them their gasoline content.

Worth-while results of gas conservation and increased oil recovery cannot be obtained without co-operation on the part of the producers, especially when the owners are numerous and the wells close-spaced as in the "town-lot" sections around Los Angeles. This is particularly true in the present situation where the overproduction of both gas and oil exists with consequently low prices for oil and natural gasoline.

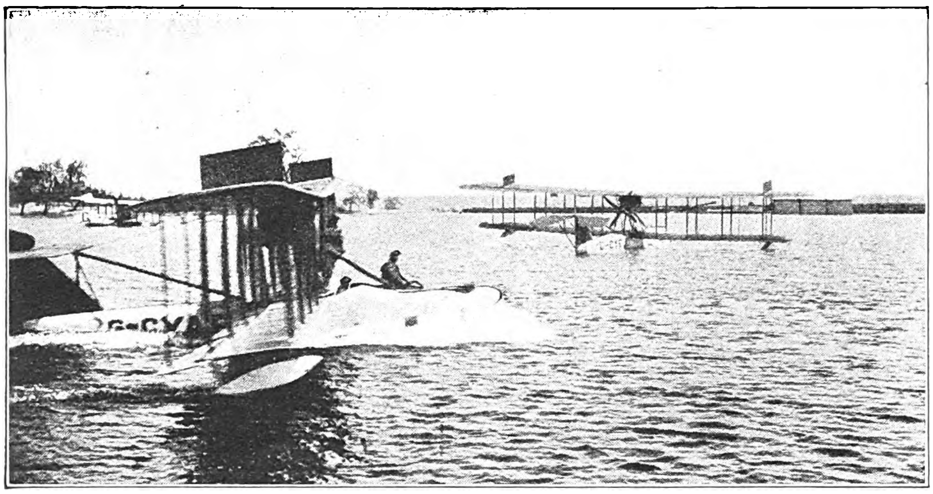




Courtesy Canadian Geological Survey

STRATA ALONG THE INTERNATIONAL BOUNDARY BEFORE AND AFTER COMPRESSION

Top: Ideal section, showing deposition of sediment and oil-bearing **sands**, 2, 3, and 5. Arches, domes, and anticlines shown below were caused by lateral compression when the Rocky Mountains were elevated. Oil and gas permeating the softer strata may collect in a fold



FLYING BOATS USED IN CANADIAN AERIAL SURVEYS
Equipped with powerful flying boats of the type shown here, Canadian cartographers are making accurate maps and forestry sketches of the little-known regions of the far north

Charting Canada's Wilderness From the Air

Rich Mineral Areas Amid Lakes and Forests of Northern Canada Mapped Accurately for the First Time

By JAMES MONTAGNES

FLYING high above the forests and lakes of the great Canadian northland, photographers are now mapping thousands of square miles of wilderness. Districts which have been mapped only by surveyors, who went into the immense country by boat and so only followed the waterways, are now being photographed from the air. Detail maps now are available, from the Topographic Survey of Canada, for a great part of the north, from Wood Buffalo Park, at the boundary of the province of Alberta and the northwest Territories, marked by the 60th parallel of latitude, down through northern Alberta, Saskatchewan, Manitoba, and Ontario to the St. Lawrence river. This region has come into prominence the past few years because of well-known mineral discoveries, and the subsequent development of water power resources.

Immediately after the World War, Canadian aviation was organized to meet the needs of a country which was but partly explored. Aerial mapping and sketching were two of the items included in the program. By the end of 1927, 162,000 aerial photographs had been filed by the Topographical Survey of Canada, and during 1928 aerial photography by the Royal Air Force amounted to 947 rolls of exposed film.

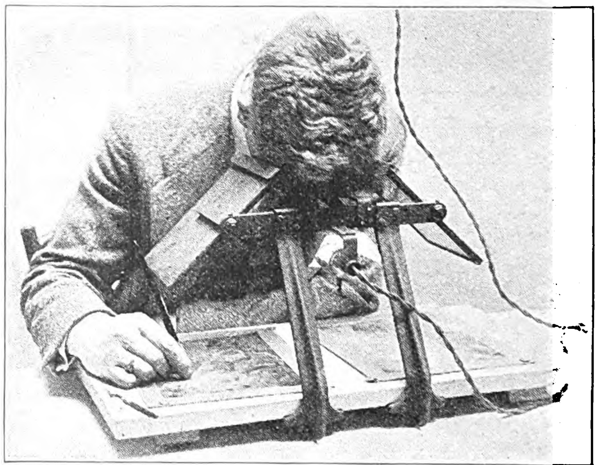
When an area has to be photographed for map-making purposes, the usual type of photographs taken are known as obliques, which are taken with a view of the entire territory to the horizon. These photos are made with a hand-operated camera mounted in the front of the flying boat used. For each picture taken, the exact angle of the camera must be noted. In order that an accurate picture of the country be obtained, three photographs are taken from approximately the same position in the air, one straight ahead, and one to each side. Since the ship is moving along at 80 to 100 miles an hour, there is a slight change in the territory taken in by each of the photographs. However, since the pictures are taken to overlap each other for at least 50 percent of the view, this deviation means very little, and when the three are put together, an accurate photograph is obtained of the country at that particular spot.

Vertical photography is employed in districts where the detailed map work requires views looking straight down. They are taken by an automatic camera set in the hull of the flying boat. Three pictures are taken of each location photographed, at 10-second intervals, with an interval of 20 seconds between each group of three pictures. Thus the overlapping is again very great, making for extreme accuracy when the photographs are used in a map.

Utilization of vertical aerial photographs for mapping purposes is very often greatly facilitated by the absence of marked relief and by the presence of the original cadastral surveys, by means of which the area had been previously subdivided into mile and half-mile squares. The fences subsequently built by the quarter-section owners around their holdings, and the traveled roads adjoining these lines, furnish a checkerboard control when such characteristics are visible from the air. In many cases the distorting effects of tilt and "slight relief" of the photograph become of negligible magnitude, in so far as they affect the reduced scale of the issued map showing these half-mile squares.

A FLIGHT crew sent into any district to take photographs will have maps of the region, marked at two-mile intervals. A ground expedition will have gone in and marked similarly the territory to be covered at two-mile intervals with certain landmarks visible from the air. These the pilot and surveyor will correlate with their maps. A line of such markings at each side of the region to be photographed allows the pilot to bring his plane to one such mark, and by compass direction fly along that line to the mark at the other end. Meanwhile, as the pilot flies from one mark to the next, the photographer is taking pictures. Oblique photographs made at a height of 5000 feet take in a two-mile region.

The same procedure is followed for each line shown on the map that must be photographed. The same route is traversed again from a height of 10,000 feet if vertical photographs of all or part of the region are required.

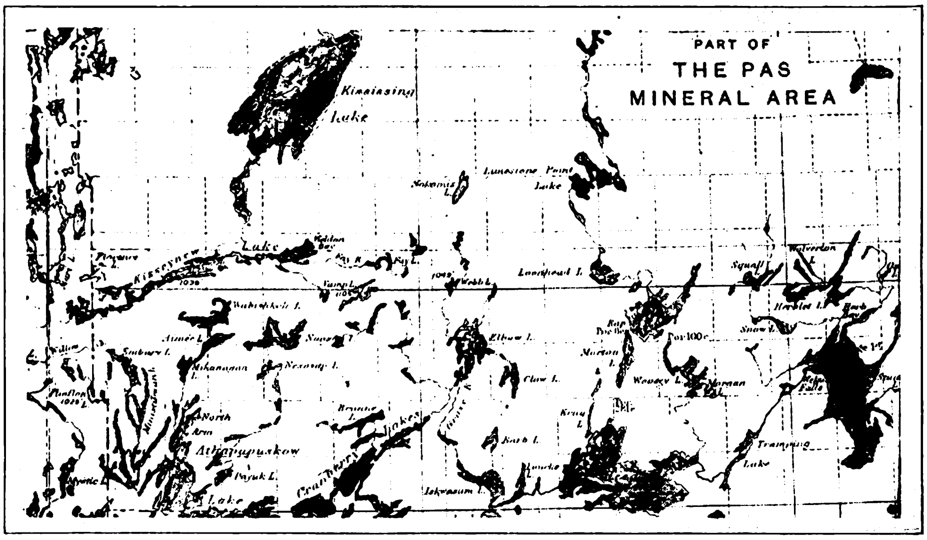


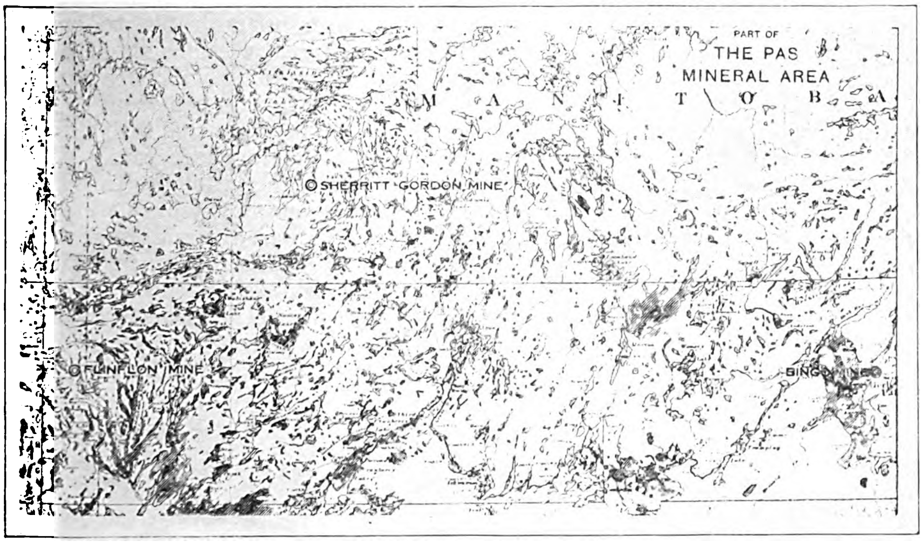
PUTTING IN THE THIRD DIMENSION
By using the stereoscope, as shown in this picture, the map-makers are enabled to calculate the elevation

Both systems, as mentioned, have an overlap in each photograph of at least 50 percent. In vertical photography this is essential so that on each photograph its principal point, the center, can be marked; by means of the detail on it, the location of the principal points of the two adjoining photographs can be found. Thus a common direction is established, between successive photos of a strip. Using clearly identifiable points selected on each photograph, one lying near each side limit of the photo opposite the principal point and appearing in the overlap common to three photographs, a skeleton triangulation is projected to the approximate scale of the photos through each strip, and intersections are made on control points at each end of the strip.

THE intersected terminal points will serve to determine the scale of the skeleton plot, and to fix the map position of the principal points of each photograph of the strip. The detail required to be shown on the finished map is next traced on the skeleton plot from the overlapping photograph, by adjusting the apparent positions of each point traced from two photographs so as to fulfil the radial assumption. The various strips are then reduced by pantograph to the map compilation or projection sheet, upon which previously have been plotted the terminal-intersected control points. Thereafter the projection sheet is rephotographed and a blue print obtained as a base for the draftsman's finished copy.

In oblique photography a grid gradually receding to the horizon is applied to each picture, in order to obtain the relative tilts and positions of the principal points of adjoining photographs. Once the directional line has been established by this method the procedure for mapping becomes similar to that for the vertical photographs.





Above: Map made by surveyors who traveled overland and by canoe, charting the major watercourses but missing many smaller lakes, rivers, and other characteristics. *Left:* The same region mapped with modern aerial photographic surveys

The value of aerial photographs outside of their use in mapping is apparent in the planning of power sites. It has been established that the feasibility of a water power or storage development can generally be ascertained by a stereoscopic study of aerial photographs, often without any field work. In cases where some field work is necessary, a preliminary study of the photographs will reduce it to a minimum, and will enable the engineer to report definitely after only a few careful measurements at critical points. In Canada, where hydro-electrical development is so often in heavily-wooded country, difficult of access, this new application of aerial photography promises to be immeasurably useful to engineers. Aerial photographs, incidentally, have also been useful in the location of transmission lines and railway right-of-way, with results that could not be obtained by any other means in the same time and with the same expenditure.

Mapping a district from the air is faster, as well as more accurate, than by the old method. Although there are but an average of 26 days a year clear enough for aerial photography, a plane operated eight hours a day with an average speed of 100 miles an hour can photograph 1600 square miles a day. The Fraser River Canyon in British Columbia was mapped from the air in one season. It had taken five years to map it on foot.

As an example of how incomplete a map may be when made by a surveyor traveling on foot and by following the water courses, aerial photographs of one district in northern Ontario revealed more than 3000 lakes that had not been shown on any other map of the region.

Forestry sketching is another highly specialized part of aviation which Canada has promoted to the utmost. A sketch map to show the location of timber of various types is made by a specially trained forester who, by means of signals to the pilot, controls the operations of the plane. Seated in the observer's hull of a flying boat, he can chart various types of timber on as accurate a map of the district as is available. This map, or sections of it, are placed in front of him in his cockpit and as he flies over evergreens, soft woods and hardwoods, burns and muskeg, he can sketch these features on the map. This type of sketch does not do away with the customary ground surveys, but it makes possible a faster and cheaper method of operating. From 30 to 300 square miles can be sketched in an hour, at a cost varying from one to ten dollars a square mile. Such a sketch map, made before a ground survey, also shows the best canoe trails and any regions of burn-over which need not be investigated.

It will take many years to complete the aerial mapping of Canada's northland, not to mention its settled areas. The Dominion, it is said, leads the world in aerial cartography, having found this method of mapping its territory accurate, cheap and fast.

Our Army's Mechanized Force

The Tank Promises to Force a Reorganization of Armies for It Is Now Much More Formidable Than During World War Days

By LEVIN H. CAMPBELL, Jr.*
Major, Ordnance Department, U. S. Army

MAJOR CAMPBELL shows here what the Ordnance Department has accomplished and what it hopes to do toward perfecting the weapon that promises to revolutionize land warfare. Since this was written, however, the Army has tested a newer tank which has given a spectacular performance—see the SCIENTIFIC AMERICAN Digest of this issue. Given time and money and the full co-operation of the automotive industry, the department may be expected to develop a mechanized force for the United States second to none other in the world.—*The Editor*

IN common with the industrial activities of the world, the Army is tending more and more to the use of machines in its organization. Mechanization as applied to the Army is defined as being the "Application of mechanics directly to the combat soldier on the battlefield." The modern machine gun and other automatic weapons quickly forced a stalemate in the World War. It soon became practically impossible for the infantry soldier to advance against the machine gun without incurring enormous losses. In an effort to overcome this condition the British evolved the tank. These machines produced in the hurry and stress of war were, of course, mechanically imperfect and left much to be desired in the way of speed and reliability. Even so, their use met with a very considerable degree of success.

Since the World War, great strides have been made in the design and construction of tanks and self-propelled track-laying vehicles of all sorts. As mechanical perfection and high speeds in such vehicles are being reached, it is quite natural that the Army should be engaged in an intensive study as to the best method of employing these types of weapons.

During the World War, tanks advanced with the infantry and, at infantry speed, became easy targets for the opposing artillery. Marching with the infantry, their tactics of employment were necessarily limited and circumscribed by the tactics under which infantry was used. Now that speeds as great as 20 miles per hour with track-laying vehicles are possible, a new method must be evolved if the maximum value is to be attained in the use of such vehicles.

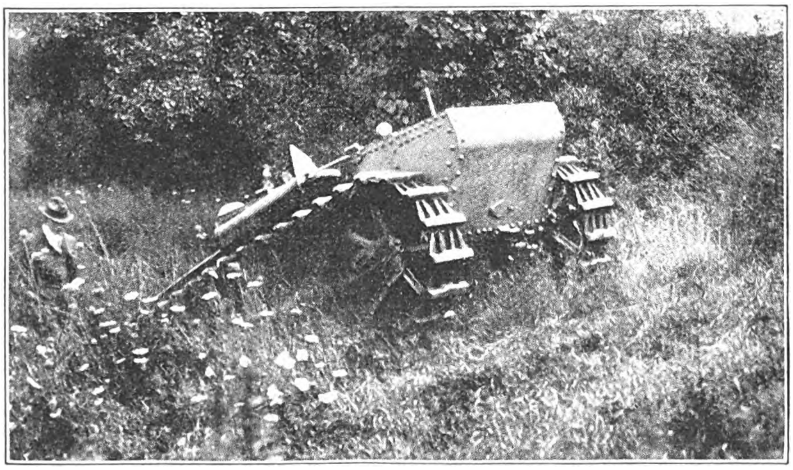
The mechanical dependability of the vehicles to be employed in a mechanized force has been greatly increased since the days of the World War. The war-time tank usually covered from 50 to 60 miles before a complete reconditioning was necessary; the new light tank recently completed a test run of 2000 miles before overhaul was necessary. The speed of the war-time tank averaged about three miles per hour while the average of the new light tank during the 2000-mile test was 12.5. The increase in dependability is thus strikingly apparent. A tank may be expected to cover approximately 50 miles during a major engagement.

Such performance specifications of the modern track-laying fighting vehicles make it obligatory to separate them from the infantry in their battle operations if the full value of a mechanized force is to be developed. The matter is quite analogous to the high-speed scout cruiser in its relation to the slower-speed battleship. To tie the scouting force to the battle fleet would serve largely to nullify the efforts of the former in contributing to the success of a naval action. The infantryman in his advance invariably makes use of all covered approaches afforded by the terrain in his attempt to escape hostile fire. The armored vehicle, however, must depend upon its speed and its armor protection for its effectiveness, and will, therefore, select the best terrain within the battle area for its operations. Thus, while the objective of the infantry and of the mechanized force may be the same, it will often be desirable to employ them in different sections of the battlefield. The infantry will be a force of one kind and the armored fighting vehicles will be organized into a unit of a totally different character.

The underlying thought in connection with the employment of a mechanized force is based upon the formula: M times V^2 divided by 2, in which M may be taken as the mass of metal thrown from the guns of the vehicles and V as the velocity or rate of movement of the force. A light tank com-

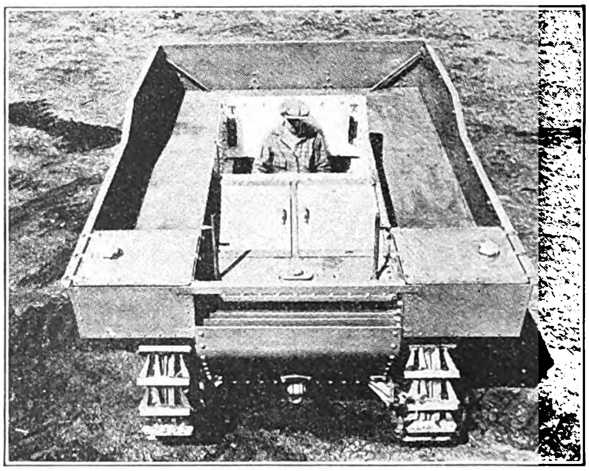
---

*See "Among Our Contributors," page 197.



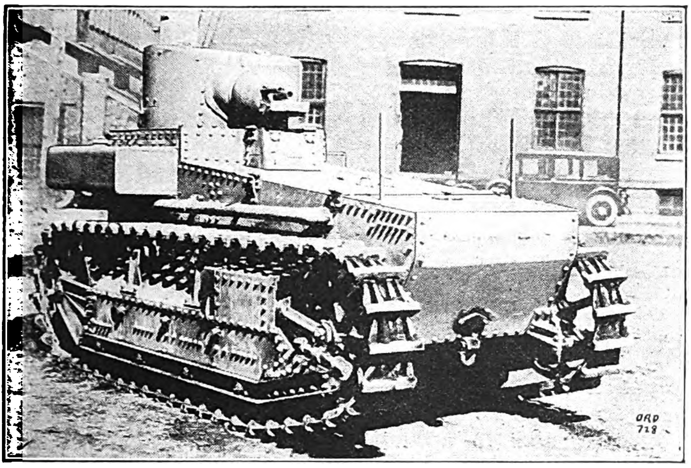
THE LIGHT TANK CHASSIS

The T1E1 chassis on which may be mounted either a light cargo body, a 75-millimeter gun, or the fighting tank hull with its complete armament



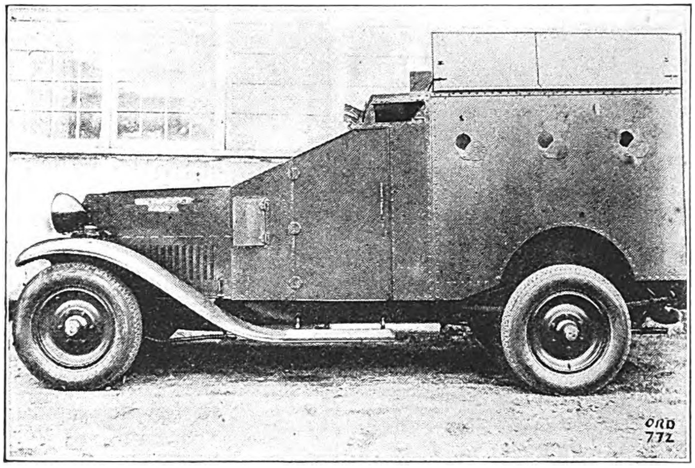
AS A CARGO CARRIER

The same chassis but with the cargo body which is used for transporting supplies and ammunition across country



THE POWERFUL TANK OF TODAY

Light tank T1E1. This machine is capable of traveling great distances without an overhaul, is speedy, and is powerfully armed

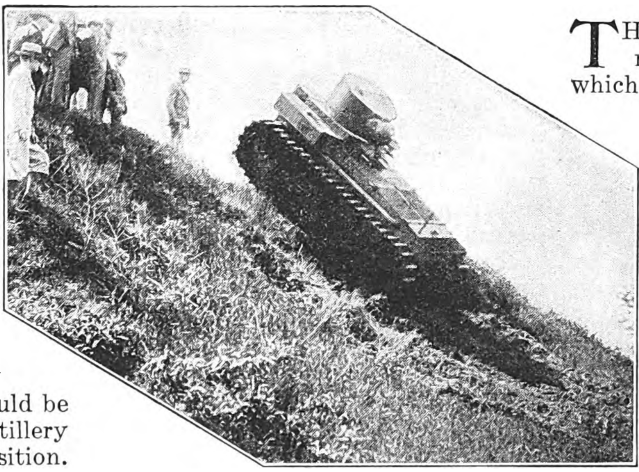


AN ASSISTANT TO THE TANK

Armored cars such as this, built on a standard commercial chassis, will reconnoiter far in advance of the Army mechanized forces

pany, which comprises 24 tanks, is capable of firing approximately 6.7 pounds of metal per minute per man, as contrasted to an infantry rifle company of 256 men, in which the output is 0.41 pounds of metal per man per minute. Over favorable terrain the elements of the mechanized force may be expected to advance at the rate of 15 miles per hour with tremendous shock effect, as compared with a normal infantry advance of approximately one mile an hour.

It is increasingly evident, therefore, that a mechanized force must, for purposes of attack, be a self-contained unit. It must possess within itself high-speed reconnaissance, high-speed attack in the battle, high-speed vehicles to afford supporting fire for the attack wave, and high-speed armored vehicles to carry its machine gunners and automatic riflemen forward to occupy and hold the objective which has been reached in the advance. The armored vehicle itself is not well adapted to serve as a holding force, as due to its size it presents a target which would be readily demolished by enemy artillery fire, should it take up a fixed position.



T1E1 NEGOTIATES A GRADE

Up hill and down hill, the modern tank rumbles, dealing death and destruction

The vehicles which have been developed, as well as those which should be developed and united to form a mechanized force, will now be briefly touched upon. If it were possible to use only vehicles found in commercial production, the ideal would at once be attained; the idealistic requirement that all items of equipment for the Army should be available or readily produced in time of war would be fully met.

THE Ordnance Department maintains close contact with the developments of automotive industry. Unfortunately the commercial world does not require high speed track-laying vehicles such as the tank, the self-propelled gun mount, the armored infantry carrier, and other types of vehicles which will properly be found within a mechanized force. The specifications must, therefore, be set up by the using services, and the Ordnance Department must produce the special vehicles thus required. However, we can and have gone a long way in reducing the war production difficulties, in the development of a track-laying chassis which is readily adapted to a wide variety of uses. This light tank chassis, T1E1, carries interchangeably, with relatively few modifications, a tank body with armament; a 75-millimeter gun; an ammunition body which also serves to carry spare parts, gasoline, oil, et cetera, portable bridge equipment, Signal Corps wire, machine gun mounts for anti-aircraft fire, the Chemical Warfare Service smoke shell mortar, et cetera. By the use of such a chassis, the production and field maintenance problems are greatly lessened.

Funds have not yet permitted of the development of the armored infantry carrier, but such a vehicle does not offer any great difficulties in design. After the tanks, supported by the self-propelled accompanying artillery, have gained the objective sought, it will, of course, be necessary to occupy the territory with machine gunners and automatic riflemen in order to ward off enemy counter-attacks. These little armored infantry carriers which we have in mind will be for the purpose of transporting such gunner squads behind armor protection to the line which it is desired to hold. The speed of the vehicles will be at least equal to that of the light tanks, and the weight will be held as light as dependable design will permit.

THE 75-millimeter gun will be mounted on the light tank chassis which will have the speed of the light tanks engaged. Supporting fire for the tanks will, therefore, be always at hand. Ammunition will be supplied to these guns by the cargo carrier.

In an effort to assure control of this rapidly moving force by the commander, wire reels will be mounted on one of the track-laying cargo carriers so that the laying of signal and telephone wire may keep up with the advance. A command tank, in which the force commander will ride, will be developed with the light tank chassis as a basis. Control will also be assisted by the radio tanks on this chassis. Only by actual maneuver under variously assumed battle situations can the equipment, and the technique of control, be worked out.

In strategic movements of the mechanized force over great distances it will be far more economical to carry the various track vehicles of the force on wheeled trucks or trailers. For this reason the weight of each of the various units should be held to that within the capacity of the commercial truck. It is quite true that the new light tanks completed a road march of 145 miles in two days at an average speed of

MUD IS NO HINDRANCE

The light tank fords streams, and turns without hesitation in very heavy mud

10.5 miles per hour during the summer of 1928. We must bear in mind, however, that the hard road is the element of the wheeled vehicle rather than that of the track vehicle, and, therefore, use of wheeled transportation for great distances should be axiomatic. When the track vehicles have arrived at their immediate theater of operations, they will leave their wheeled transport and carry out their battle mission. The trucks will then be sent back to the base and will return with the necessary gasoline and oil to permit an extended maneuver by the mechanized force. The supplies will be unloaded at the side of the road, and the track cargo carriers will carry forward from that point.

ALL marching columns in the next war will be subject to attack by hostile planes. A vehicle of great usefulness within the mechanized force will be found in the self-propelled multiple machine gun mount on the T1E1 chassis. These multiple machine gun mounts will serve to hold the planes at a greater altitude, which will make their bombing and machine gun operations less effective. The mechanized force, being composed entirely of track-laying machines, can, upon the approach of hostile planes, immediately leave the roads and present a widely dispersed target to the attacking planes. The anti-aircraft machine gun mount will also be used against ground targets.

In adopting and organizing a mechanized force, the Army is merely paralleling industry in its effort to increase the fire power of the individual engaged. As previously stated, the fire power of a light tank company composed of 112 men is approximately 16 times that of an infantry rifle company composed of 256 men, as expressed in pounds of metal thrown per man per minute. We must add to this figure the great loss of morale produced by an armored vehicle rushing at high speed toward the enemy troops. No longer will the machine gun be able to hold up the advance, as the tank will be impervious to its fire. Indeed, it will be difficult to hold the machine gunners to their post in the face of such an assault. It will be impracticable for field artillery guns to register upon the fast-moving mechanized force, which will normally launch its attack as a surprise. The self-propelled 75-millimeter gun mounts will closely support the attack of the tanks with their fire, as they can be moved forward from one position to another in a minimum of time and at the speed of the advancing tanks.

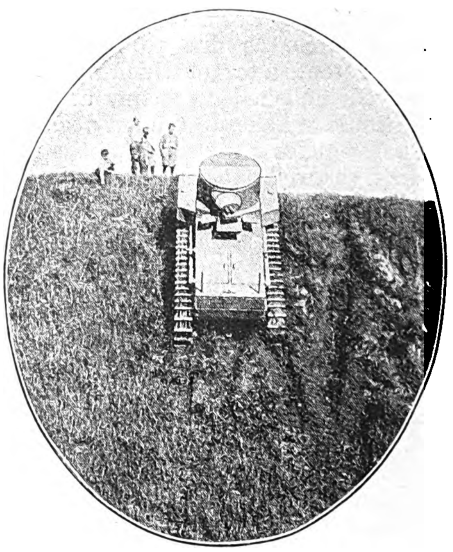
After the objective has been gained by the tanks and the ground occupied by the machine gunners, who have been carried forward in the armored infantry carriers, these supporting guns will assist in beating off enemy counter-attacks. They will hold their position until relieved by the wheeled carriages of the field artillery. The operation of the mechanized force requires a lesser number of men, and consequently the battle losses will be very materially less. The personnel will be protected by the armor and speed of their vehicles, and their objectives will be gained in much less time.

THE mechanized force will secure reconnaissance by the use of attached airplanes, by its wheeled armored cars operating over improved roads, and by its tanks. An accompanying photograph shows the latest type of armored car which consists of an armor plate hull on a commercial passenger car chassis. These cars will operate normally far out in advance of the mechanized force and will reconnoiter the highways to the front. Track-laying vehicles will comprise the entire combat units of the force. Under favorable conditions of dry ground, the wheeled vehicles will leave the road and operate cross country. The necessity of military operations in time of war is, however, unfortunately not limited to fair weather and dry ground. The track-laying vehicle possesses the greater ability successfully to negotiate soft ground than any other man-made machine applicable to the armored force.

The mechanized force will have no vehicle within its combat organization which does not measure up to the requirement that it contain within itself the full limit of the art as regards cross-country mobility. There is no question but that wheeled vehicles are much more economical in operation on hard roads than are track-laying vehicles. The primary sphere of operation of the mechanized force is not, however, on the roads, but rather *off* the roads. Consequently it will be composed of vehicles of the most efficient types designed to execute the recognized purpose of such a force. The illustrations of the light tank operating over typical terrain of mud and grades, show the necessity for track-laying vehicles.

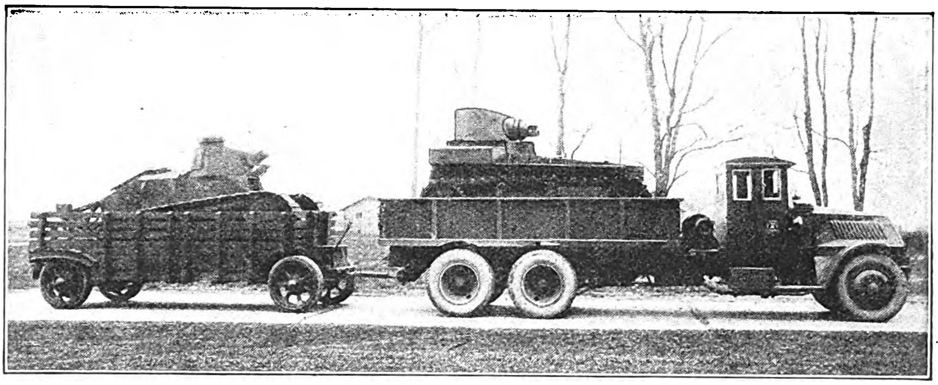
THE ideal combination in a vehicle is one that will permit of efficient operation both on the roads and cross country. Such a combination is to be had in a wheeled vehicle which is adapted to receive a track over and around all of its wheels when operating off the roads. Much time and money have been spent both here and abroad in the development of such a combination. The necessity for the use of such a vehicle within the mechanized force may be developed, and if so it will doubtless follow that the engineering ability to be had will evolve a satisfactory machine.

For reconnaissance well to the front of the mechanized force, a possible combination is offered by using a commercial truck to transport the light tank. One tank can be carried on a commercial truck, while another is carried as a trailer load. While traveling on the road, should a more detailed reconnaissance to either flank be required, the tanks are run down off the truck and trailer and then proceed under their own power to gather the information desired. The reconnaissance is made behind armor plate protection and at a relatively high speed. Upon accomplishment of the immediate mission the tanks return to their carriers, and reconnaissance is carried farther to the front. The advantages of using such a combination lie largely in economy in the use of available vehicles; the commercial truck on the one hand, and the light tank, a component part of the mechanized force,



OVER THE TOP

Testing a light tank. The motor of this tank is powerful, speedy, and efficient



RAPID SERVICE TO THE FRONT

A commercial truck with trailer moving two light tanks at high speed over improved roads. In the eight-ton truck is a T1E1 light tank while in the 10-ton trailer is a six-ton light tank

on the other. These two vehicles must in any case be provided for other necessary uses within the Army.

The weapons of the soldier of the mechanized force will be the machine gun and the automatic rifle while the tanks will be equipped with semi-automatic cannon. The force will thus have within itself the maximum of fire power as expressed by the most modern weapons.

The force, with its mobility and fire power, will prove most valuable in advance and in rear guard actions. A practically uninterrupted advance of the main body will be assured by its use in the advance guard, until such time as serious enemy resistance is met with. In its function as a rear guard, the enemy's pursuit will be sufficiently delayed to permit of the uninterrupted and unharassed retreat of the main body. The great speed of the mechanized force will make it of particular value in turning movements and in enveloping the enemy's flanks.

The medium tank of 15 tons in weight is too heavy for truck transportation, and as such will not be a part of the mechanized force. Medium tanks will be attached upon occasions when heavy resistance is to be overcome. With their heavier armor and three-pounder semi-automatic guns they will lend greater striking power to the force. Their speed will be sufficiently high to advance at the rate set by the other units of the mechanized force. The Chemical Warfare Service smoke-shell mortar, when mounted on the light tank chassis, will be an important unit with the force. Losses in both matériel and personnel will be greatly lessened by the correct use of smoke in the battle.

A mechanized force will most certainly not revolutionize warfare; it will prove but another weapon of great power at the disposal of the commander. Obviously, changes in tactics must be made to incorporate the force correctly within the Army. Not until such a force has been organized and equipped with modern vehicles can its full use be understood and appreciated. We may all theorize, and we are all entitled to our individual opinions, but the following words of Admiral Mahan seem to be particularly applicable to this whole subject of mechanization:

"The student will observe that changes of tactics have not only taken place *after* changes in weapons, which necessarily is the case, but that the interval between such changes has been unduly long. This doubtless arises from the fact that an improvement of weapons is due to the energy of one or two men, while changes in tactics have to overcome the inertia of a conservative class; but it is a great evil. It can be remedied only by a candid recognition of each change."

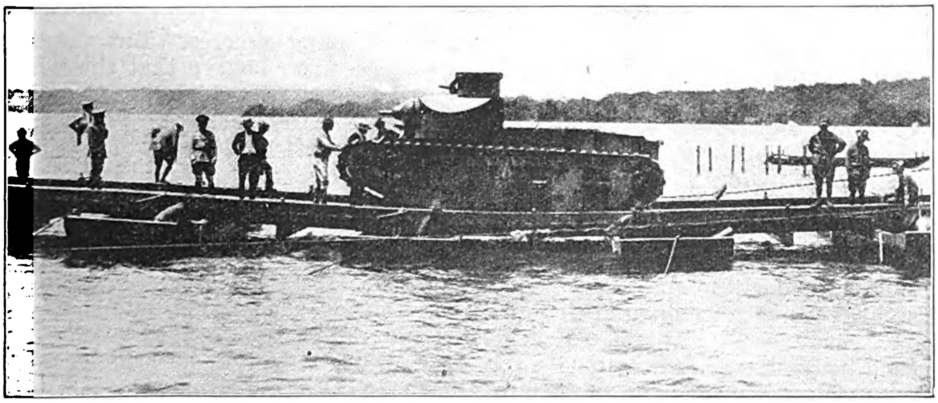
Many people, through lack of opportunity for observation of modern automotive equipment applicable to Army uses, are prone to judge tanks and other armored vehicles by the performance standards of the war-time vehicles. This leads to gross errors in evaluating the possibilities of the situation. We all recognize that the automobile of 1929 is a vastly superior car to that of 1916. The present-day armored fighting vehicle may be considered in the same manner. The statement has authoritatively been made that even in the case of World War tanks the casualties of the Tank Corps were the lowest in percentage of men killed compared with total casualties in other arms. If those crude machines served to lessen the battle losses, surely those of this modern day will be even more effective.

During the summer of 1928 a small force, equipped with motor transportation and tanks, was assembled at Fort Leonard Wood, Maryland. The equipment was largely of war-time construction which, in large part, precluded obtaining the correct picture of the capabilities of a modern force. Many valuable lessons were learned, however, and a start in the right direction was made. When funds become available for the supply of modern equipment, the full possibilities of such a force will be recognized.

A committee of eminent engineers of the Society of Automotive Engineers, has, since 1919, been of great value to the Army. All of our automotive projects have been submitted to its members at bi-annual meetings, held usually at some great plant of the industry. We have received constructive criticism and helpful advice and we have been given access to the latest developments in the automotive industry.

As great as is the wealth of our country, we cannot afford to keep a military establishment equal to that which we will require to prosecute successfully a major war. We can afford, however, to equip and maintain a small modern mechanized force, which will serve as a laboratory for the development of machines and the training of personnel in the tactical employment of such an arm. To the establishment of the Army charged with the design and procurement of such vehicles in time of war, the peace-time development of but a few of these vehicles will be of advantage in reducing the time required to reach quantity production.

We should not wait until the ideal is reached in automotive development. Such will never be reached in an industry which is making such rapid strides. We should not be deterred from entering into the procurement of the necessary vehicles for a well-organized and well-equipped mechanized force. We should make a start; the developments and logical improvements will rapidly follow.



UNDER ITS OWN POWER

A medium "A" tank, model 1921, crosses a pontoon bridge in a test. Since this tank weighs 23 tons, the crossing test showed the feasibility of such tactical maneuvers in actual warfare

What Becomes of the Star Light?

The Stars Send Out Their Light into Empty Space. Does It Go On Forever? If Not, Where Does It "End"?

By HENRY NORRIS RUSSELL, PH. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

WE ordinarily speak and think of the night as dark. But the darkness of one night is very different from that of another. When the clouds are thick, and hang heavy over the sky even in the day, the night may be very black. But even then there is a difference between the darkness under the overcast sky and that of a closed room. One can hardly imagine a night so dark that an open door or a window giving upon the sky would be wholly invisible if one were in a cellar.

But on a clear night, although the moon is quite out of the way, things are altogether different, and the sky sends us a really very considerable amount of light. Anyone can realize this when he thinks how black the dense foliage of a tree appears against the summer sky. Most of the light comes, not from the stars which are separately visible, but from the background. Indeed, this is bright enough to dazzle the eye—strange as this may seem—and to make the stars look less brilliant than they otherwise would.

We all know how a star seen through a small chance gap between the leaves of a tree looks far brighter against the dark background than it would on an open sky. A more precise test of this effect was made years ago by Curtis at the Lick Observatory. He found that by viewing stars through a small hole in a large black screen many feet away, objects could be seen which were less than one fifth as bright as the faintest which could be detected directly, even in the clear mountain sky.

THIS background light of the sky comes from three main sources. Part of it reaches us from the telescopic stars too faint to be seen separately with the naked eye; another part comes from diffuse matter, probably meteorites, scattered through interplanetary space and illuminated by the sun—an extension of the zodiacal light; while the rest arises in our atmosphere as a faint but permanent auroral glow.

The careful work of van Rhijn indicates that five sixths of the light of the sky on a clear moonless night comes from the last two sources—diffuse matter and glow in our atmosphere—so that if we could get outside the earth's atmosphere, and what is more, beyond the sun's attendant fog of sparsely scattered meteorites, we would find the stars standing out on a far blacker background than earthbound mortals can ever hope to see. The Milky Way, instead of appearing about twice as bright as the sky remote from it (as it does to us) would be ten times as bright; and the dark nebulae which lie in front of it would be far more conspicuous than they are now.

If we could thus escape into interstellar space we would none the less find it far from dark. The stars in a hemisphere of sky give fully 500 times as much light as a single star of the first magnitude, or about 1/600th of the light of the full moon, and this would be light enough to enable eyes like ours to pick out a path pretty well if the light from the sky were not obstructed by atmospheric or other obstacles.

NO place in space within the confines of the galaxy is really dark, unless it is artifically darkened by the interposition of some barrier—whether a cloud, the roof of a cave or a man-made enclosure—between it and the vast light-filled spaces without. Even if we should flee in imagination far beyong the Milky Way—beyond interstellar into inter-nebular space—we would not find it utterly dark. If all the light which we received from the galaxy could be blotted out, leaving only that which comes from the extra-galactic nebulae, we would still get at least 1/10,000th as much light as we do now from the galactic stars, and probably about 1/1000th as much. A white surface lighted on one side by the nebulae alone would be illuminated about as much as by the rays of a star of the second magnitude. This is pretty faint; yet a normal human eye, if rested in perfect darkness for 10 or 15 minutes, can see a white object lit only by such a star.

To find a perfectly dark region of space we would have, therefore, to go beyond the region where the nebulae are scattered—that is, beyond the utmost limit of vision of the greatest telescopes—if we did not bury ourselves in a dark nebula and shut out the heavens with its opaque cloud.

Whence comes this light which fills space, and whither is it bound?

A child can answer the first query: "From the skies, of course." But no man can yet make bold to reply with assurance to the second. Some things we know—or can at least deduce from the observed facts. The light which escapes from the stars *keeps on going* (unless stopped by the accident of falling upon matter), ever onward with its prodigious and unalterable velocity, and there is no interference or confusion between the light of one star and of another. This second point deserves a word of comment.

If we should think of light as consisting of rays joining the stars through our eyes, or even the particles moving along these ray-lines, we might question what would happen if two rays intersected or two particles collided. But the newest physical theories confirm the conclusion of the older ones that light, when under way in empty space, behaves as waves would do. We have all seen how one set of waves on the surface of still water may cross another, and each set pursue its way unaffected; and we shall do better to think of light under this image than to picture it in terms of rays or particles.

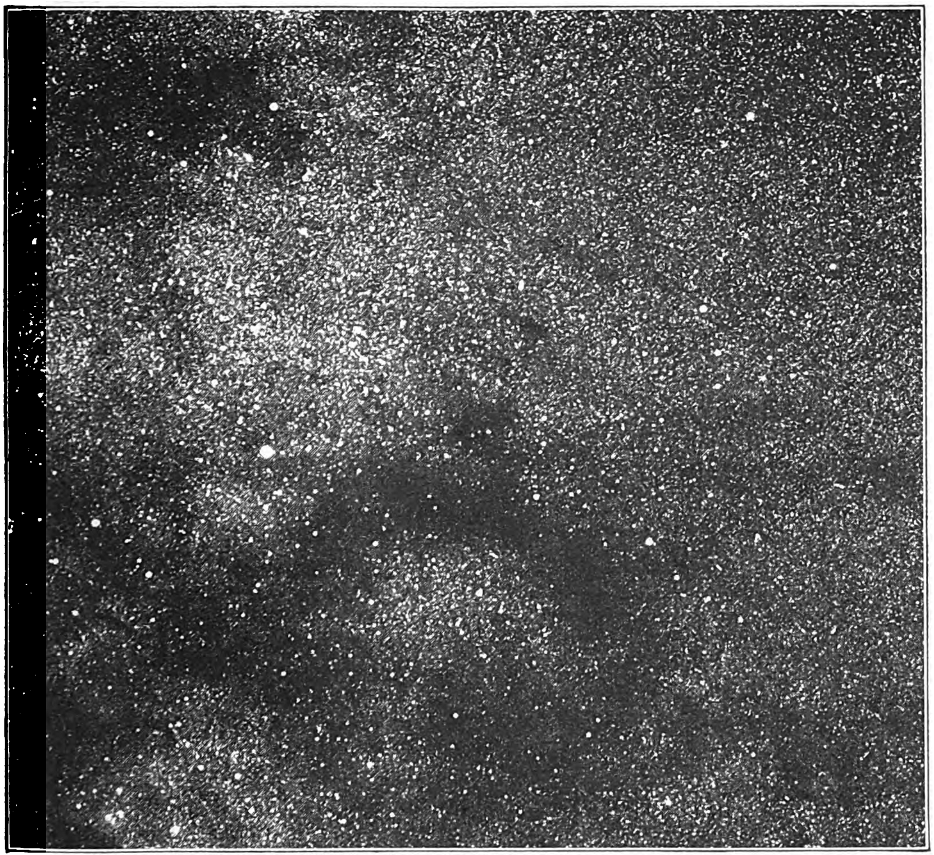
STRICTLY speaking, we do not *know* anything at all about light on its travels in empty space. We can obtain knowledge only by catching the light on some material body. But these observations have never shown any indication that the light coming from one body interferes in any way with the light from another. Light from many thousands of stars together enters simultaneously into the lens of one of the great modern astronomical cameras, and the light of each star is brought to its own proper focus unaffected by that of any of the rest.

Nor is there any evidence that light is weakened in its passage through space. It spreads out, of course, in ever widening spheres. But there is good reason to believe that the whole amount of energy which these expanding waves carry suffers no perceptible diminution after a journey of a million years.

But does the light go on *forever?* The question is by its very terms beyond the power of observational science to answer. It is however, a legitimate subject for speculative thought, and the question is asked so often that something may well be said about it here.

Many different answers are imaginable. First; space may be infinite in extent and the radiant energy may simply fly on and on forever, spreading out into the boundless abyss. This is the simplest of all answers, and for all we know it may be true.

Second; space, although without boundaries, may return into itself (as the surface of the earth or of any sphere does) and the light, after having gone "around the world," may come back. It is not a serious objection to this theory that a good deal of mathmatical training is required to understand what it really means. But a difficulty arises when we think that in this case we should be able to see at least some of the most luminous of celestial bodies—like the great nebula of Andromeda—by light which has gone "around the world" the long way as well as by the shortest path. This should give us a faint small image of the nebula at a point in the heavens exactly opposite to that in which we see it directly, and no such faint nebulae have yet been observed. This does not prove that the hypothesis is wrong, but only that it is a very long way around the whole circumference of space if it is curved. For the present the question must rest unsettled.



From Barnard's Atlas of Selected Regions of the Milky Way. Courtesy Carnegie Institution

"THE LIGHT MAY BE STOPPED BY FALLING UPON DARK MATTER"

Area, about 15 degrees square. Star clouds; also dark patches—of what? This is not positively known, but the evidence suggests that they are some kind of dark, diffuse nebulae

Third; the light may be stopped by falling upon dark matter scattered diffusely through space. The dark nebulae show that this actually happens in many regions within the galaxy, and similar obscuration occurs in the outer parts of spiral nebulae. Whether there is a thin haze of "cosmic dust" all through space we can not as yet determine. It is entirely possible that there may be; but light is evidently able to come pretty freely to us from the remoter of the great nebulae, so that the "mean free path" of the radiant energy before it is obstructed must be many millions of light years. This suggestion does not, however, go to the root of the problem, for such dark matter can not continue indefinitely to absorb the energy which the stars radiate to it without getting hot, or at least warm, itself. It will then radiate out energy on its own account and in time a balance will automatically be struck between the income and outgo. The dark nebulae, therefore, can in the long run act only as relay stations for the radiant energy, and after tarrying awhile it will again be on its way. Our eyes with their limited range may be no longer able to see it, but it will still be

"On the old trail from star to star
"A wanderer and a vagabond."

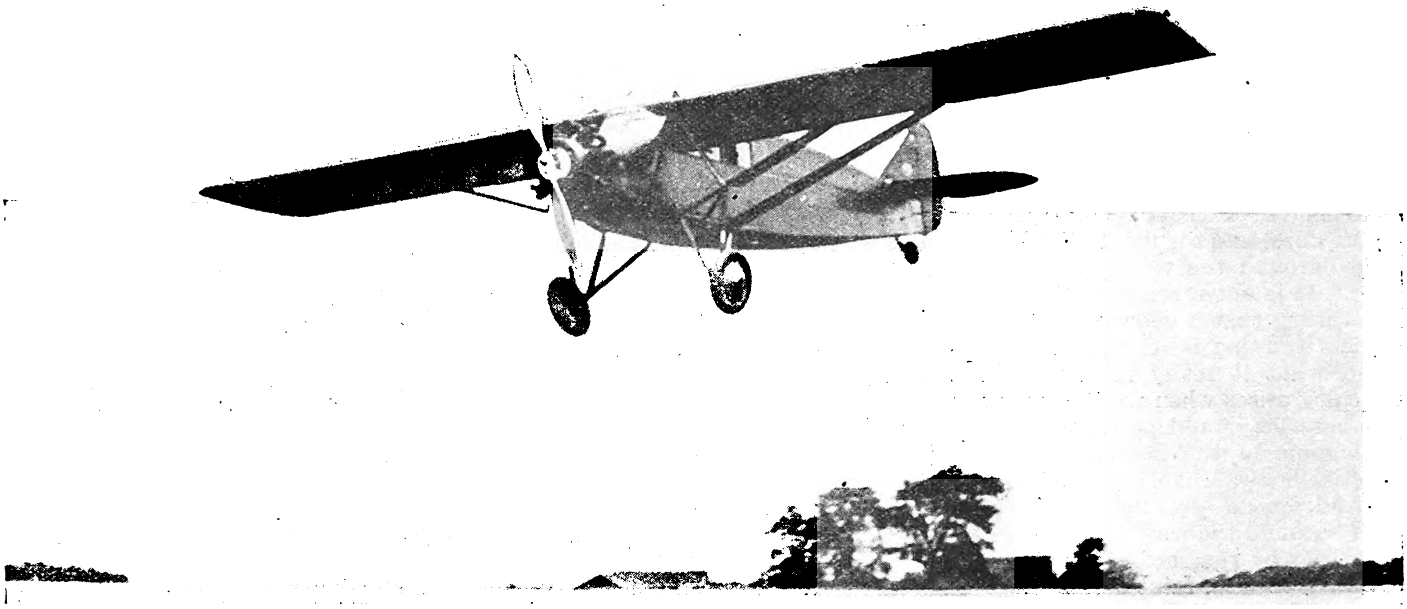
Last; the radiant energy may in some way, of which we can gain only the vaguest conception, be arrested on its way and turn back into the equivalent of energy—material atoms. This is a bold speculation, but many distinguished mathematicians and physicists favor it. There is strong evidence that the reverse process—the breaking down of ordinary matter, with the appearance of the enormous amount of energy which, on Einstein's principles, is equivalent—actually happens inside the stars and keeps them shining. If this happens without compensation the material universe is indeed decaying, and pouring its very substance out in floods of light into the inaccessible depths of space.

The hypothesis that the conversion of light back into atoms also happens is therefore necessary to a belief that the universe of matter and energy is really permanent in anything like its present form, renewing itself through perpetual change. This philosophical conception has been brought within the range of scientific study by Millikan's theory that the cosmic rays which he has studied so effectively arise from the formation of heavy atoms out of positive and negative electrons.

To account for the presence of the latter in the otherwise empty depths of space from which he concludes that the rays must come, he assumes that they have been produced by the transformation of the light of the stars and nebulae back into the simplest forms of matter; and that this transformation occurs in the coldest and emptiest parts of space, while that of atoms into energy happens in the intensely hot interior of the stars.

It would be premature at present to pronounce decisively either in favor of this hypothesis or against it. The alternatives have not been exhausted, and some of the latest theoretical work on the absorption of very short waves by matter indicates that the cosmic rays carry even more energy than Millikan has supposed, and may result from the disappearance of stars rather than their formation. But this, too, is not settled.

For the present the narrator has only to review the various possibilities, and leave the reader to his own choice. That choice will probably be made—and quite legitimately—in the absence of positive evidence, on the basis of one's general philosophy. To some the idea of a universe that is running down, never to repeat its history, is abhorrent and the cyclical conception of the endless recurrence of new-born stars and worlds, although never twice just the same, is beautiful. Other people feel differently. The writer, who can hardly help expressing himself, is inclined to agree with Professor Eddington, both in his conclusion that the actual evidence indicates that the universe of stars is in "its first innings" and has not passed through the same history before, and in his comment, "I am an evolutionist not a multiplicationist. It seems so tiresome to keep on doing the same things over and over again."



Courtesy Packard Motor Car Company

SIX HUNDRED AND FIFTY MILES FOR $4.68

The cost for fuel for this Stinson-Detroiter Diesel-engined plane in a flight from Detroit to Langley Field, Virginia, was less than one quarter of that for the same flight in a plane equipped with a standard type of radial engine using the ordinary gasoline combustion system

Is the Airplane Diesel Practical?

A Summary of the Opinions, pro and con, of Men High in the Aeronautical Industry

By REGINALD M. CLEVELAND

> IN the article presented here are the views of several men high in the aviation industry concerning the practicability of Diesel engines for airplanes. In the main, their comments are adverse to present use in the air of this engine which has so ably proved itself on land and water. It is a moot question, however, as is evidenced by the fact that, as the article points out, many manufacturers have been working for years to adapt the Diesel to airplanes. We hope, therefore, to be able to present in the very near future an article which will show what has actually been accomplished with these engines.
>
> —*The Editor*

WHEN, last Spring, a Stinson-Detroiter monoplane flew from Detroit to Langley Field, Virginia, powered by an oil-burning engine designed for the Packard Motor Car Company by Capt. L. M. Woolson, new stimulus was given to a problem which has been engaging the attention of the engine departments of the airplane industry for a number of years—the adaptation of the Diesel type of engine to airplanes. The successful flight with this radial, oil-burning power plant, aroused intense interest not only among those present at the annual meeting of the National Advisory Committee for Aeronautics, but also among designers and engineers generally and the air-minded public at large.

It would be easy to argue, from the fact that this engine on this particular flight consumed furnace oil costing approximately $4.68 as against a normal cost for gasoline in a conventional engine of something more than 25 dollars, that new economies for general operation were definitely in sight. Such a conclusion, however, should not be arrived at with undue haste.

The advantages usually emphasized for the Diesel type engine for airplanes include:

Low cost of fuel.

Elimination of fire hazard, due either to electric ignition or to back-fires through the carburetor—since both ignition and carburetor are eliminated.

Decreased fuel consumption.

The possibility—not yet demonstrated in flight—of using a two stroke cycle with consequent low engine revolutions at moderate speeds, and a resultant increased efficiency of the propeller.

Elimination of interference with radio communication due to the absence of electric ignition.

Disadvantages frequently brought forward include:

Greater specific weight.

Higher first cost.

Difficulties of maintenance due to the fuel injection system used.

Objections to the fuel itself—probably somewhat readily overcome — on grounds of non-uniformity, lack of cleanliness, and less widespread distribution of supply sources.

It is admitted that the Diesel type advantages are highly desirable if they can be attained in a service engine fit for manufacture and production and for every day, all-condition use. On the question, however, of how close at hand the realization of such an engine actually is, there is by no means a meeting of minds among those best qualified to speak. It is a subject which is engaging the attention of leading aircraft motor manufacturers everywhere, both in this country and abroad.

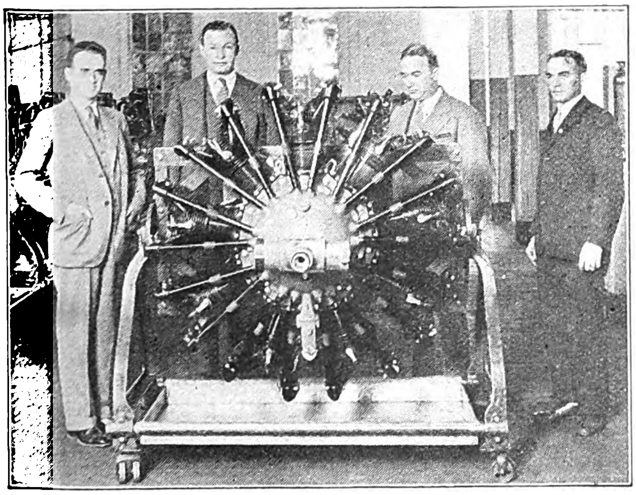
THERE is one school of thought which holds that the dawn of the adaptation of the oil-burning principle to airplanes is near at hand. The Packard organization, with the record of successful test operation in the flight of the Woolson motor already behind it and with an expenditure said to be very large in preparation for the production of such an engine, is naturally of this school. C. M. Keys, for some time President of the Curtiss Aeroplane and Motor Company and now holding the same office in the Curtiss-Wright Company, resulting from the recent merger with the Wright Aeronautical Company; of the Transcontinental Air Transport, and other important factors in the aviation field, recently predicted the use of the airplane Diesel type as a not distant development.

The General Motors Corporation in its purchase of the Allison Engineering Company, laid emphasis on this field of endeavor when Alfred P. Sloan, Jr., President of General Motors, in announcing the purchase, said:

"The Allison Engineering Company for some time past has been engaged in various developments of a mechanical nature and has recently been giving considerable attention to the development of aviation engines, including those of the Diesel type."

In Germany, Junkers and others are working upon the oil-burning type of engine and Junkers recently reached the stage of flight. In Great Britain, William Beardmore and Company, Ltd., of Glasgow, Scotland, have constructed a heavy-oil engine of the semi-Diesel type, giving interesting results upon the test block, and which, although not as yet designed for heavier-than-air craft, is intended for aeronautic use in the dirigible *R-101*.

In this country, every important airplane motor manufacturer may be said to be watching oil-burning engine development with the closest attention, and, in many cases, to be conducting experiments of his own. Among these, in addition to those already referred to, are Henry Ford, the Westinghouse Electric and Manufacturing Company and the Emsco Aero Engine Company of Los Angeles. The National Advisory Committee of Aeronautics is constantly pursuing its studies of the many problems arising in the design of compression-ignition motors suitable to aircraft.



F. B. RENTSCHLER (SECOND FROM LEFT)

"I can see . . . no likelihood that it (the Diesel) will replace the general type of motor which is proving satisfactory today"

Courtesy Aeronautical Chamber of Commerce of America

C. M. KEYS

Mr. Keys predicts that the use of the Diesel airplane engine is a not distant development

With all this wide-spread interest and actual experimental research actively underway, there is, however, another distinct and definite school of thought which holds that the Diesel principle, however interesting, is by no means as yet adaptable to airplanes and may never be so in a wide sense.

F. B. Rentschler, President of the United Aircraft and Transport Corporation and its subsidiary, the Pratt and Whitney Company, manufacturers of Wasp and Hornet airplane engines, told the writer that he saw no reason to believe that the oil-burning engine would displace the present radial, air-cooled, ignition type.

"Fundamentally," said Mr. Rentschler, "the question of flight comes down to weight per horsepower. While there have been improvements in plane design and in airplanes, considered aerodynamically, since the war, the great forward strides have been primarily in motor efficiency.

"When the Wrights first flew, the motor weighed aproximately 16 pounds per horsepower. The plane was barely able to fly. Today, radial air-cooled engines have been brought down to one and one half pounds per horsepower. The flying ability of planes thus equipped needs no comment. The inherent nature of the Diesel type engine, with its increased compression and higher internal pressures, demands a heavy engine, and while reductions in weight may be effected by improvements in design and by the use of newer metals, I do not foresee that weight can be reduced to a point where the Diesel will be competitive with the standard radial engines of today.

"While it is of course desirable to eliminate—considering the matter from certain angles—fuel supply by means of a carburetor, this may also be done without going to the Diesel type. Direct or solid injection may be accomplished with the gasoline motor and interesting developments along this line of thought and with the super-charger are indicated by the experiments of some manufacturers.

"There are other objections to the oil-burning engine besides that of weight. I do not feel that the use of comparatively heavy oils will prove advantageous under the service conditions which airplanes must meet in flying as it is conducted in the United States. Even in summer at high altitudes, very low temperatures are recorded, while in winter, temperatures of 50 degrees below zero or less are not uncommon. In our various Canadian services such temperatures are considered standard. The behavior of heavy fuels under such conditions seems to me, to say the least, problematical.

"We are of course extremely interested in the Diesel development and are watching it closely in the domestic field and through our connections abroad. We have even experimented with designs of this type, but I am prepared to go on record as saying that I can see no need for its adoption at present nor any likelihood that it will displace the general type of motor which is proving so satisfactory today."

COMMANDER BRUCE G. LEIGHTON, Director of Sales and Service of the Wright Aeronautical Corporation, whose Whirlwind and other engines have blazed so bright a trail across the sky of aviation, also holds that the adoption of oil-burning engines for aircraft to any general degree, will not come soon.

"An airplane motor," he said, "must be considered as an integral part of the plane; not something which is attached, nor an external force. The problem is one of applying the units of energy contained in a pound of fuel with the least waste and most directly to the pound of pay load. When we fly, what we really are doing is to use the old principle of jet propulsion. We introduce raw fuel, combined in the correct proportion with air, into the motor, burn it and thereby cause the motor and, in turn, the propeller to revolve and the propeller, with its wide span becomes in effect a broad jet pushing out a stream of air. The wings are so designed as to make use of the speed thus developed to lift, not only themselves, but the power plant and the pay load of the plane.

"Really, in the simplest terms, what we do is to make digestible to the motor, by cooking, the hydro-carbons contained in the fuel just as we make digestible, by cooking, the fuel for the human body contained, let us say, in a potato. The problem becomes one of making this cooking process as complete, efficient, and controllable as possible.

Courtesy Aeronautical Chamber of Commerce of America

COMMANDER B. G. LEIGHTON

". . . I do not envision it (the Diesel) as an imminent, practical development"

"The only essential differences between the Diesel type engine—and the engines so-called thus far applied to aircraft are not strictly of the Diesel cycle—and the conventional gasoline engine are that, in the one, raw fuel is injected into the compression chamber where it is mixed with air already drawn in and fired by reason of the high compression brought about by the design and travel of the piston, while in the other—the conventional internal combustion engine—fuel and air are mixed in predetermined proportions in the carburetor, supplied to the cylinder in vapor form, and fired therein by means of an electric spark.

"The internal pressures generated in the compression-ignition engine are so high as to necessitate a weight of metal which makes the whole engine roughly twice as heavy as the conventional type with its one and one half pounds per horsepower. The saving in fuel consumption of the oil-burning type is approximately 20 percent—by no means enough to compensate for the doubling in weight.

"Furthermore, there are many complicated difficulties about injecting fuel direct into the cylinder—the solid injection principle—which seem to me to militate strongly against this type of engine as a general service type or a production job. It is necessary, with solid injection, to put a very exactly measured charge into the cylinder at a very exactly determined time in the cycle of the stroke. Quantities must be exactly the same for each cylinder. With a 9-cylinder radial engine of this type, the variations as to time should not exceed one one-thousandth of a second, and the variations as to quantity must be held within almost equally narrow limits. Moreover, the quantity must be controllable as this control provides the entire throttle action.

"These complicated problems surrounding the injector pump have been met in *experimental* engines of both single and multi-cylinder types. But they seem to me to present a very real and serious objection from the manufacturer's point of view when it comes to production, and from the service point of view when one considers the variety of conditions, both natural and human, to which the modern airplane is subjected.

"We could doubtless turn out within a year an oil-burning multi-cyclinder airplane engine which would fly from here to there. But, vitally interesting as the Diesel principle is, particularly if it should lead to a two-cycle motor, I do not envision it as an imminent, practical development."

Charles L. Lawrance, President of the Wright Aeronautical Corporation, is of the same mind.

"I adhere to the viewpoint," he said, "that such an engine is not yet right for wide-spread use. It is a decade away."

SOME interesting observations on the requirements of Diesel type engines for aircraft have been presented by C. H. Schowalter of New York University, before the American Society of Mechanical Engineers. Mr. Schowalter said in part:

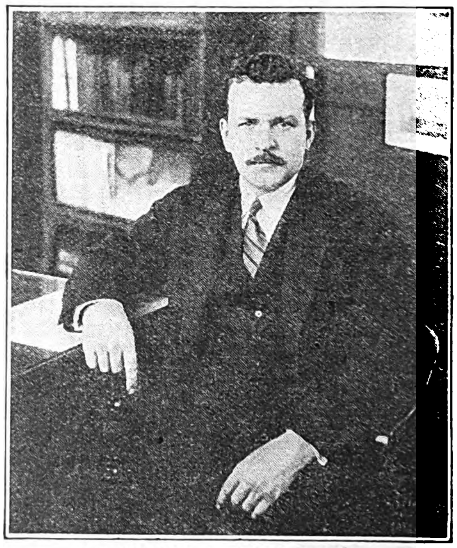
"Because of the outstanding success of the air-cooled carburetor engine, the buying public will be in favor of, and the design tendency will be toward, air-cooled Diesel aircraft engines. This method of cooling can, and is, being utilized in the design of both radial and in-line engines. In-line engines, however, need special cowling to direct the air flow.

"Any light-weight Diesel engine intended for the commercial aircraft market should not only be designed to meet the 50-hour endurance test required by the Department of Commerce, but should be able to operate many hours in excess of that limit. Extensive reliability and durability tests, under conditions of actual service, should be made before attempting to introduce it for general use. Vibration, lubrication, cooling, leakage through joints in the engine proper and in the piping system, should all be carefully checked. Performance of the engine should not only be checked under normal conditions but also under all abnormal conditions that could possibly be encountered in service.

"For cylinders of the size that would normally be used for aircraft purposes, the problem of fuel distribution and quantity regulation is of major importance. From the results of tests made by the National Advisory Committee for Aeronautics, the spray penetration and distribution for any particular size and shape of nozzle can be predicted. Combustion chamber and injection nozzle design can thereore be inter-related. The proper relation between these parts, and the design of the fuel supply and control mechanism are fundamental problems confronting the designers of light-weight, high-speed Diesel engines today.

"When using the Diesel engine, the main objection to the two-cycle carburetor engine, that of fuel passing out through the exhaust parts, is not present. An advantage of using this system, in the case of the Diesel engine, where reciprocating parts are of higher weight, is that with an explosion stroke for every revolution of the crankshaft, the inertia forces would be counteracted during each stroke and the crankpin more uniformly loaded.

"The effect of continued or sudden maneuvers, or of an abnormal flight path, on the fuel injection system must be watched when this unit is being designed. Reliable functioning of this mechanism under all conditions of service is important, even though the airplane in which the engine is installed is not expected to be used for any except straight flying.



CHARLES L. LAWRANCE

". . . such an engine is not yet right for wide-spread use. It is a decade away"

"Since the air-cooled carburetor engines have been developed to a high stage of perfection, through years of experimentation and use, it will be necessary for any aircraft Diesel engine that may be developed for the commercial market to duplicate its qualities of durability, reliability, and low weight per horsepower."

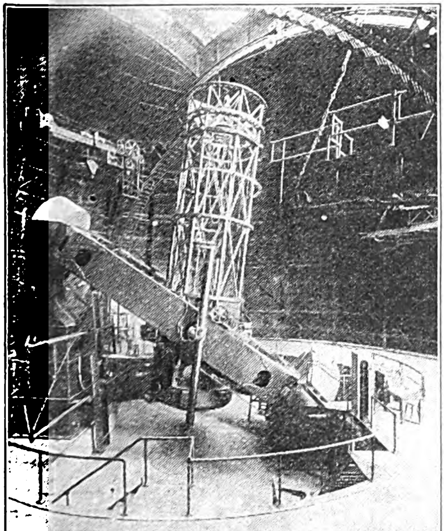
Silvering the World's Largest Telescope

A Witness Describes This Fascinating Process

OUR readers will recall that Russell W. Porter of Vermont, Corresponding Editor of this journal, co-author of the SCIENTIFIC AMERICAN book "Amateur Telescope Making" and in the last analysis the man to whom the American amateur telescope maker now owes the most, was called to California last year to take part in the design of the optical shops required for the construction of the much talked of 200-inch telescope, and to co-operate on the design of that great telescope and other instruments.

Mr. Porter has now spent several months in Pasadena, where the great telescope is to be made, as Associate in Optics and Instrument Design at the California Institute of Technology which is building the telescope in cooperation with the Mount Wilson Observatory.

RECENTLY he sent one of the editors a sketch and informal description of resilvering the 100-inch mirror of the Hooker telescope at Mount Wilson Observatory. This description seemed so vivid that his permission to publish it was obtained, and it was suggested that he illustrate it with a further sketch. This appears above. The first sketch, which may be seen on the front cover, was copied from Mr. Porter's pencil drawing and colored according to his specifications by our regular front cover artist, Mr. Howard V. Brown. Mr. Brown, by the way, is himself an amateur telescope maker and is thus twice an artist.


Courtesy Mount Wilson Observatory

THE GREAT TELESCOPE

The large man-hole to which Mr. Porter refers, here closed, may be seen, although only faintly, below the end of the tube

At Mount Wilson the silvering solution is customarily divided into two parts, and silvering is done accordingly in two stages. Mr. Porter's description follows:

"This morning I saw them silver the 100-inch mirror. They do this twice a year. You can imagine the 'kick' it gave me when they flooded the big disk with some three pounds of silver-nitrate in solution.

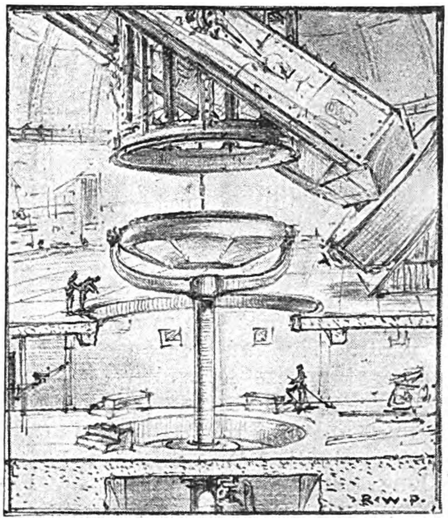
"It is a full day's job. They begin about four o'clock, unfastening the cell that holds the mirror from the tube. I arrived about nine, and they were then just starting to mix the chemicals. I asked Mr. Ellerman, the astronomer, why he had not taken photographs of this very striking operation and he replied that he never had the time, since he was so busy in charge of the proper mixing of the solutions. So I made the sketch, enclosed. (See cover.—Ed.)

"AS you probably know, the main floor has a large man-hole which is removed, and the mirror in its cell is lowered into a pit. To accomplish this there is provided a huge fork on the end of a plunger. This rises to the telescope tube, which has first been firmly anchored in a vertical position. The end of one of the anchor bars shows in the sketch. The bolts are removed, and down the whole affair goes like an elevator.

"The silvering process used is the one all amateur telescope makers are familiar with, that is, the Brashear process; except that all is on a grand scale. A band is drawn tightly around the disk. This band has a sluice-way on one side, with a wooden gate. The cell trunions rest in the fork, and this allows the mirror to be rocked through a small angle.

"The old coat of silver was first removed with acid and the glass given a thorough scrubbing with cotton swabs on the end of long sticks. This is the operation shown in the sketch—water is there being supplied through a hose.

"The solutions were prepared on the floor above, in four large square glass jars—one man to a jar. When they were ready to silver, the reducing solution was first poured over the disk, and half the silver (two jars) added. After a few moments the depositing solution was stirred and the flocculi were kept moving with the swabs. Then the rest of the silver was poured on. It was left on for half an hour, with constant stirring meanwhile.



Sketch by Russell W. Porter, M.A.

LOWERING THE BIG MIRROR

The plunger has risen to the 4½ ton disk, which was then detached and is descending to the pit, there to be resilvered

"Then the sluice gate was opened, the spent solution was poured off, and the disk was thoroughly washed. The band was removed and the surface dried with chamois skin. The chamois was 'flipped' to the center, dragged to the edge and wrung out.

"When dry the coat was given a hard scrubbing with absorbent cotton. Then a huge pad some three feet in diameter was attached to a 20-foot power crank-arm and the film was burnished with a circular stroke, the disk meanwhile slowly rotating underneath. The pad was covered with chamois charged with rouge, but it was first used with a cotton pad over it, and later with the chamois skin itself.

"THE entire operation of silvering this largest of all mirrors was carried through with clock-like precision. Some dozen men were employed and each one had his appointed task. While there was some good-natured banter back and forth, one could see that they took a warrantable pride in the work they were doing.

"The silver film was of the order of one hundred thousandth of an inch thick. I figure that this amounts to a cube of silver about three eighths of an inch on a side. This is a small proportion of the original three pounds—not much over 1 percent.

"I could not help, while they were working on the big disk, trying to visualize the whole affair increased to double its diameter, as will be the case with the 200-inch mirror. This will mean four times the area, and that will be some surface.—Porter."

Foiling the Burglar—III

The Invisible Guardians of Wealth Are Little Clocks and Disks of Metal

By ALBERT A. HOPKINS
Author of "The Lure of the Lock"

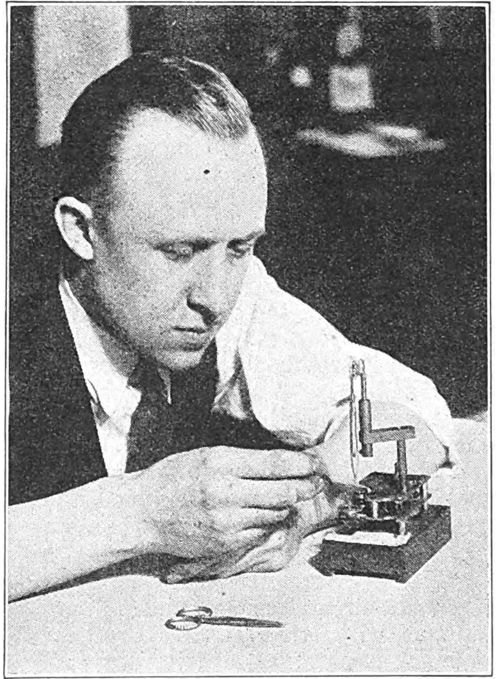
EVERTHING which deals with crime has interest. The burglar's "jimmy," his mask, his drills, his torches, his "soup," are never-failing sources of "copy" to the reporter, cub or otherwise. It is astonishing that there should have been no work of any importance on locks issued from 1852 to 1928. It is for this reason that we have run the series of articles entitled "Foiling the Burglar." Burglary as a profession is a losing one, not recommended for the younger generation and these articles have told why.—*The Editor.*

IN the first article of this series we saw how the banker early tried to protect his property and the property of others; we now develop the theme at greater length, presenting some unique pictures of a very essential industry. In the second article we described the "first line of defense"—the vault. The vault, however, is no stronger than its locks. When the combination lock was invented, bankers thought that the millenium had arrived. But their security was not of long duration, for, as we have shown, the so-called "masked burglar" loomed up behind every cashier's bed.

Thoroughly impressed with the gravity of the situation and the imminent danger of these new conditions, Mr. James Sargent, the celebrated lock inventor, oblivious of all other considerations, devoted himself, day and night, to devising and developing plans for a lock which even the custodian of its combination could not open until the predetermined time for unlocking.

HIS native ardor and the growing exigencies of the case became an inspiration to his genius, and his plans were speedily completed and without an hour's delay they were being embodied in a model; within a few weeks from the first stroke of a pencil in making sketches of the parts, a complete time and combination lock, combined in one case, was ready.

When burglars become convinced that it is impossible for bank officers to open their safes out of banking hours, there is no longer any inducement for an attempt to compel them to do what is out of their power, and when burglars are aware that a bank has a time-lock, the officers are secure against such assault. Even if taken to the bank, an officer can demonstrate that there is a time-lock on the safe, by asking his assailants to listen to the ticking of the timer, by placing their ears against the safe door.

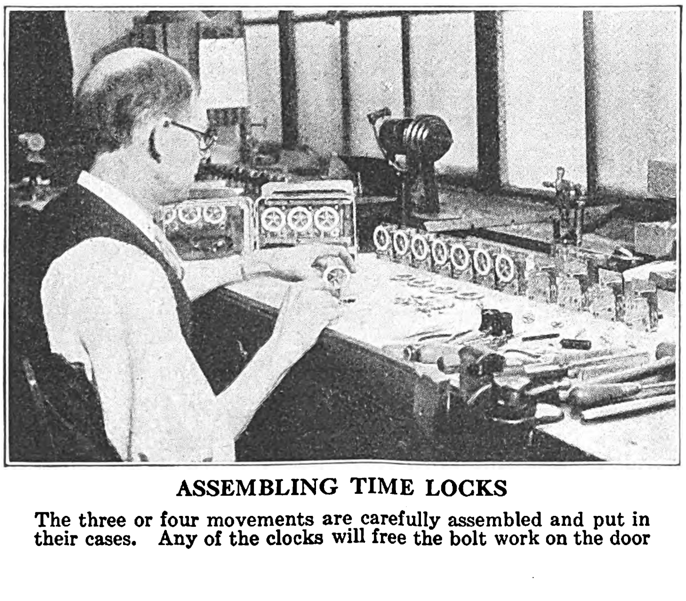


All photos courtesy Sargent and Greenleaf, Inc.

TIME LOCK PARTS COMPARED
The balance wheel is oscillated until it attains the beat of the master movement

In one instance, many years ago, a time-lock had been attached after banking hours on a certain day, and the safe locked up to open at a certain hour the next morning. The bank had no suspicion of any premeditated attempt to rob it, but, during the following night, a gang of masked burglars secured the cashier, took him to the bank and the leader ordered him to open the safe. He assured them that he could not open the safe because it was protected by a time-lock. This they indignantly denied, telling him that the leader was in the bank the day before, saw the door standing open, and that there was no time-lock on it. He informed them that it was put on only the evening before and that if they would place their ears against the door they would hear it tick. The leader listened for a moment, as directed, and, turning to his fellows, said, "It's no use, boys, here's another six weeks' job gone." They hastily left.

THE time lock affords the highest type of protection on a vault from the inside, for after a door is once locked it is beyond human agency to effect entrance until the fore-ordained time. Thus again the inventor has made the way of the burglar still harder. While there is life

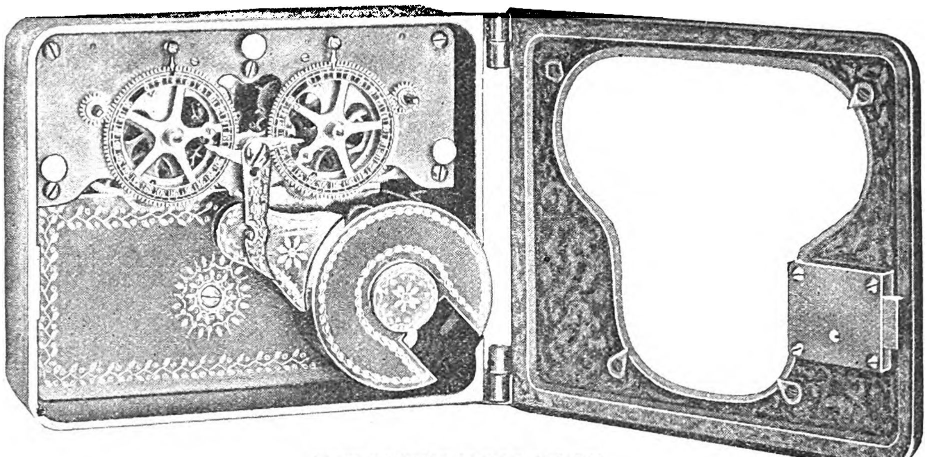


ASSEMBLING TIME LOCKS
The three or four movements are carefully assembled and put in their cases. Any of the clocks will free the bolt work on the door

SETTING THE JEWELS
The jeweling is done as carefully as in any of the finest watches. The jewels are spun into position with the aid of a burnisher

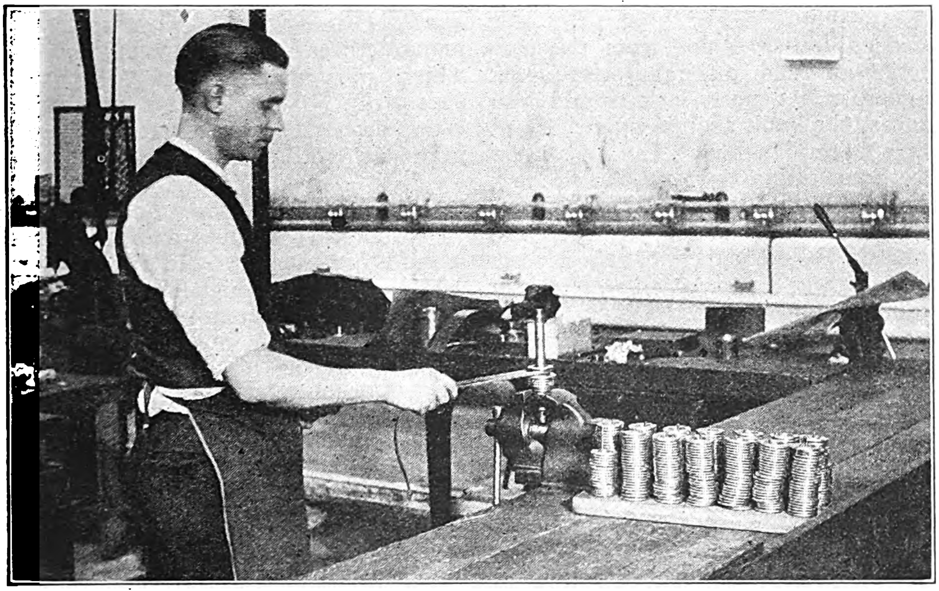
in the body, however, the cracksman will continue his nefarious proceedings although he could make a much better living with a tin cup and a glib tongue. Once a burglar always a burglar comes very near to being the truth.

The early time locks consisted of two movements and were usually connected directly with the combination locks; that is, the combination lock could not be operated until the time lock was run down. Now, time locks are used independently of the combination lock, or any other locking device on the vault door. They really constitute a secondary defense in the guarding of safe and vault door mechanism. The modern time locks are usually built with three or four movements. Each movement, however, is capable of doing the work alone. It may be of interest to know there is no case on record where a complete lockout was caused through the failure of a time lock.



THE FIRST TIME LOCK

The first time lock was sold in 1874 to the First National Bank of Morrison, Ill. In a short time there was a demand for similar locks for safes and vaults all over the United States



"LIMBERING UP" THE TUMBLERS

Giving the wheels or tumblers harsh treatment to show defects, also to free the complete set, making them run smoothly. No combination lock in actual use receives such severe usage

THE movements of the time locks are made with the same degree of accuracy as high-grade watch movements. They are sturdily built to withstand any shock, and are made throughout of corrosion-proof materials. As a regulating device on these movements is not desirable, it is necessary to time and adjust the hair spring at the factory with a great degree of accuracy. To accomplish this a special master movement and fixture was devised to time these hair springs. This is shown in one of our illustrations.

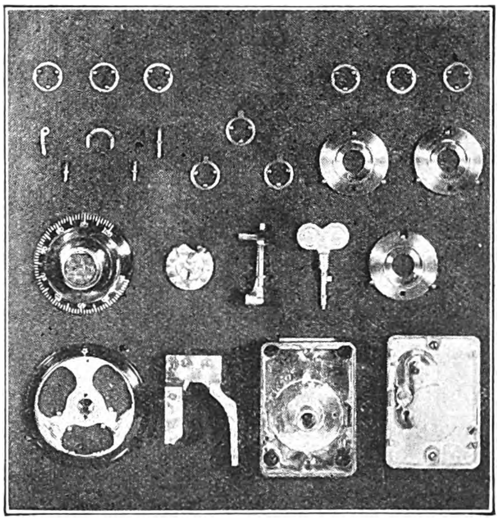
Our next illustration shows the method of setting jewels. All of the jewels are set in separate housings, and the jewels themselves are set in these housings by means of a watchmaker's lathe and special fixture. As the outside diameter of these jewels varies, the jewel itself is used as a gage for counterboring the jewel housing. The housing is then counterbored and the jewel is put in by means of hand tool and burnisher, thus being firmly spun into place. In the assembling department the various parts are assembled and put into the various cases. The movements themselves are largely standard, but they are made in a large number of sizes and cases.

In our first article we described and illustrated the essentials of the combination lock which, like all other articles of its kind, has passed through a period of evolution, and the modern combination lock is as different from the early type as the present automobile is from the 1900 model.

The first problem is one of strength. Therefore, every part of the combination lock must be designed with a view to the possible stresses to which it may be subjected under any conditions, and this work begins primarily with the patterns of the various parts entering into it. All stresses are carefully calculated and patterns are designed in accordance with these calculations.

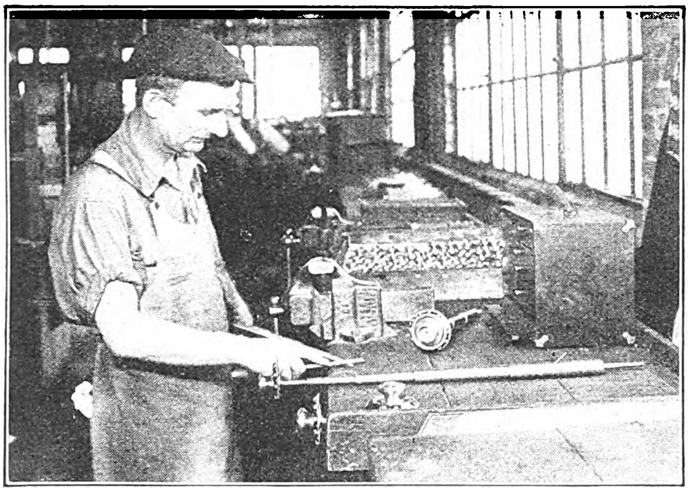
In high grade combination locks using three or four wheels, the changes are numerous. A three-wheel lock will give a possible million changes, and the four-wheel lock one hundred million changes.

AS a protection against forcible entrance, various means are used. The most common is the use of the combination lock in connection with what is called the burglar-proof spindle. This is a hardened steel spindle, made with various steps, to prevent the spindle either being driven in or pulled out. Usually this spindle is built directly into the safe or vault door by the safe maker. The inner end connects directly with the driving wheel of the lock, the outer end with the combination dial. Another precaution is to operate the combination lock by means of an "outside shaft." This is



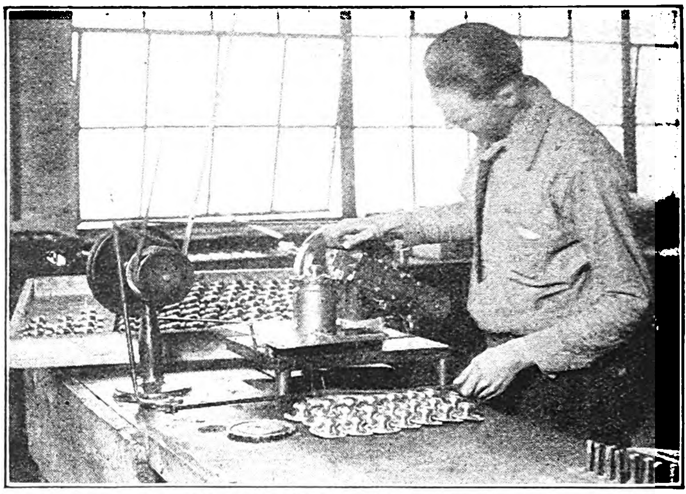
COMBINATION LOCK DISSECTED

Here we have all the parts of a key-changing lock laid out for examination on a board



FITTING SPINDLE AND DIAL

The spindle is made of high grade tool steel. The spindle is not all hardened uniformly. This prevents any breakage at the steps



GRADUATING THE DIALS

Most dials are black with white enamel. Square cut graduations instead of the ordinary V-shape give an anchorage for the enamel

an extension to the lock case, housing a series of gears, the spindle not entering directly into the lock.

In one of our illustrations is shown an interesting method of what is called the "limbering up" and testing of the wheels, this being one of the final operations. After the wheels are completely assembled and inspected, they are put together in sets, ready for the lock. The complete set is then put on a special fixture, the top wheel attached to a pulley, and the operator, by means of a strap, rapidly revolves these wheels back and forth.

Another interesting operation is the graduating of the combination dials. This is done in a special machine, and as the dial is completely turned up, it is mounted on the machine and the graduations are cut by means of the narrow cutter inserted in the head of the machine.

ONE of our illustrations shows a burglar spindle prepared for the fitting of the dial. This spindle is of the "pull-off" type. The dial may be removed from the outside at any time, and the end of the spindle is cut in such a way that the dial can only be put on in one way.

The spindle is made of high grade tool-steel throughout. Turned to within five to eight thousandths of the finished size, it is then hardened. The hardening itself is not uniform throughout the spindle, the spindle being left soft at the corner of each step to prevent breaking at these points. The spindle is then put into grinding machines and ground to a tolerance of one thousandth, plus or minus.

JUST as time and combination locks are intended for protection for the outside door of the safe or vault, so the safe deposit lock is a protection for the individual safe deposit box inside of the vault. The problems involved in the safe deposit locks are somewhat different from those of the time and combination locks. Aside from the protection afforded to the renter of a box, a good safe deposit lock should also protect the bank against unauthorized entrance into a box. The lock must also be so made as to require at least two persons—one an official of the bank and the other a renter—to open the box. In the early days of safe deposit vaults it was customary to place two ordinary key locks on the door. These were either set one above the other, or tandem fashion—that is, one behind the other—in which case the rear lock acted as a check on the front lock. the next development embodied the two complete lock mechanisms in the same lock case, which in its earliest form was a double nose lock with two complete sets of tumblers.

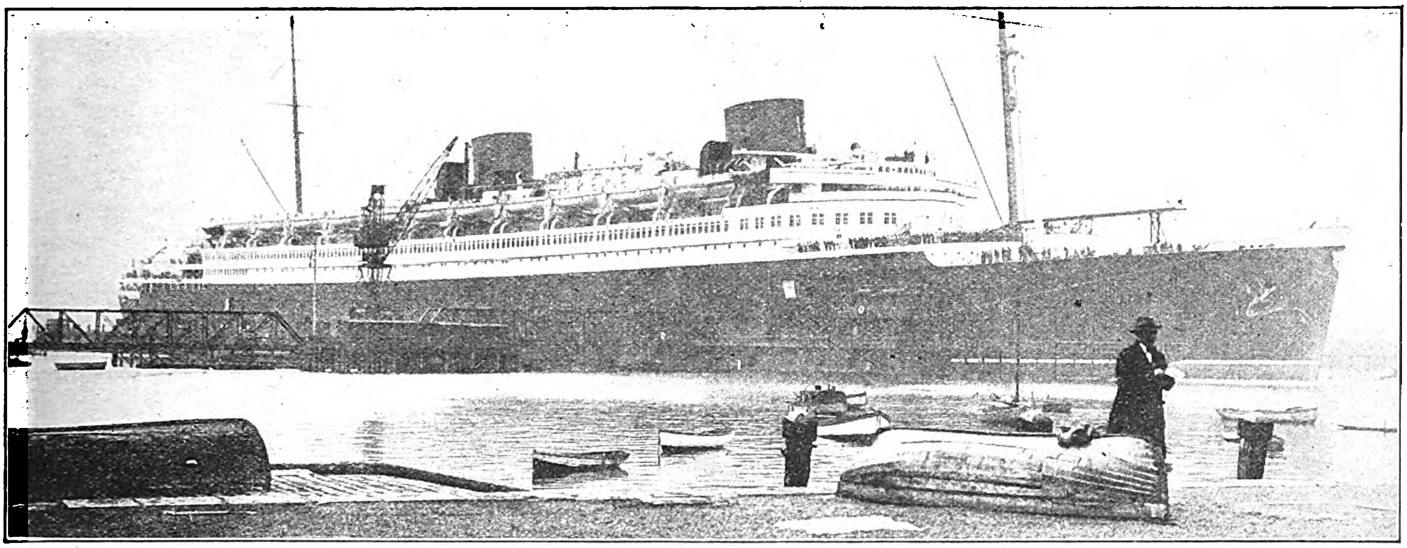
In the manufacture of safe deposit locks, particularly locks of the changeable type, the keys are the most important part of the lock. It is quite obvious that where there is an installation of 5000 locks, and 5000 sets of keys are furnished, every set must fit in one of the 5000 locks, and as the manufacturer has no means of knowing which particular set of keys will eventually be used with a particular lock, extreme interchangeability is, therefore, vitally important.

TO maintain the desired accuracy of these keys Sargent and Greenleaf found it necessary to build a special key cutting machine, which is shown in our illustration. This is a ten spindle machine, and will cut keys for locks having as many as ten tumblers in one pack. Because of the complete key being finished in one operation, extreme accuracy is insured, and the usual errors which occur when handling keys a number of times are avoided. The dials on the machine are graduated in accordance with the key code—the combination being read directly from the codes—and the dials set for each separate set of keys.

The writer is indebted to Mr. W. F. Diesel, Vice-President and Treasurer of the Rochester concern for many courtesies in connection with the preparation of the present article.

PUTTING SECRECY INTO SAFE DEPOSIT KEYS

The complete key is made at one operation. The dials on the machine are graduated in accordance with a key code. The dials are set accordingly for each separate set of keys



THE NORTH GERMAN LLOYD LINER "BREMEN"

This new German steamer, the longest merchant ship in the world, is equipped with up-to-date safety apparatus of all descriptions, and is an excellent example of progress in safety at sea. Her devices for launching lifeboats are second to none for efficiency and speed

Last Call for Sea-Safety Contest

THE competition for the SCIENTIFIC AMERICAN Medal awarded by the American Museum of Safety will close on September 30, 1929, so there is still time to send in designs or projects. The descriptions should be typewritten and in the English language and the drawings should be clear so that the members of the committee may readily understand the idea. Projects can be sent either to the American Museum of Safety, 141 East 29th Street, New York, or the office of the SCIENTIFIC AMERICAN, 24 West 40th Street. It is fortunate that at least two members of the committee of award were present at the second International Conference on the Safety of Life at Sea recently held in London, so that competitors may feel that their designs will be passed upon by experts who are fully abreast of the times. The principal designs of merit submitted, as well as the winning one, will be illustrated in the SCIENTIFIC AMERICAN as soon as the committee of judges has finished its labors.

It will be some time before we have the full text of the code just framed in London. During the period between the holding of the first conference, after the sinking of the *Titanic*, and the second conference, that met in the shadow of the *Vestris* disaster, conditions at sea were far from satisfactory. Rules for safety lacked uniformity among the maritime nations. Why this was so, Rear Admiral J. G. Tawresey, U. S. N., has explained:

"A number of governments that had participated in the conference, including the United States, failed to ratify the convention, and it never came into full effect. Further, the World War followed within a few months and resulted in all shipbuilding being taken over for the governments."

The foundering of the *Vestris* was due in part, it has been brought out, to defects in construction and her lifeboats were not all placed where they could be readily got at and lowered. It was high time that another safety conference should be assembled to bring order out of the complexities of regulation and draft; a uniform code to bind the seafaring nations of the earth is necessary.

THE United States delegation was carefully selected. "I feel safe in saying," remarked the chairman, Representative Wallace H. White, before going to London, "that there must be more extensive use of wireless on small ships." The Americans held that the problem of better designing of interior structure was the most important question that the conference would have to deal with. Load lines were bound to provoke discussion. Great Britain had long complained of the unfair competition of overloading by other European nations. As Mr. White said, the United States has been "open to severe criticism" until Congress enacted recently a law establishing load lines for American ships.

The bitter experience of the *Vestris* disaster showed conclusively that we had become careless about safety at sea. It is a tragic thing that some such accident always seems necessary to awaken us to the risks we run, but it would be even more tragic if, having the example of the *Vestris* before us, we failed to adopt the precautions which this expert committee advises.

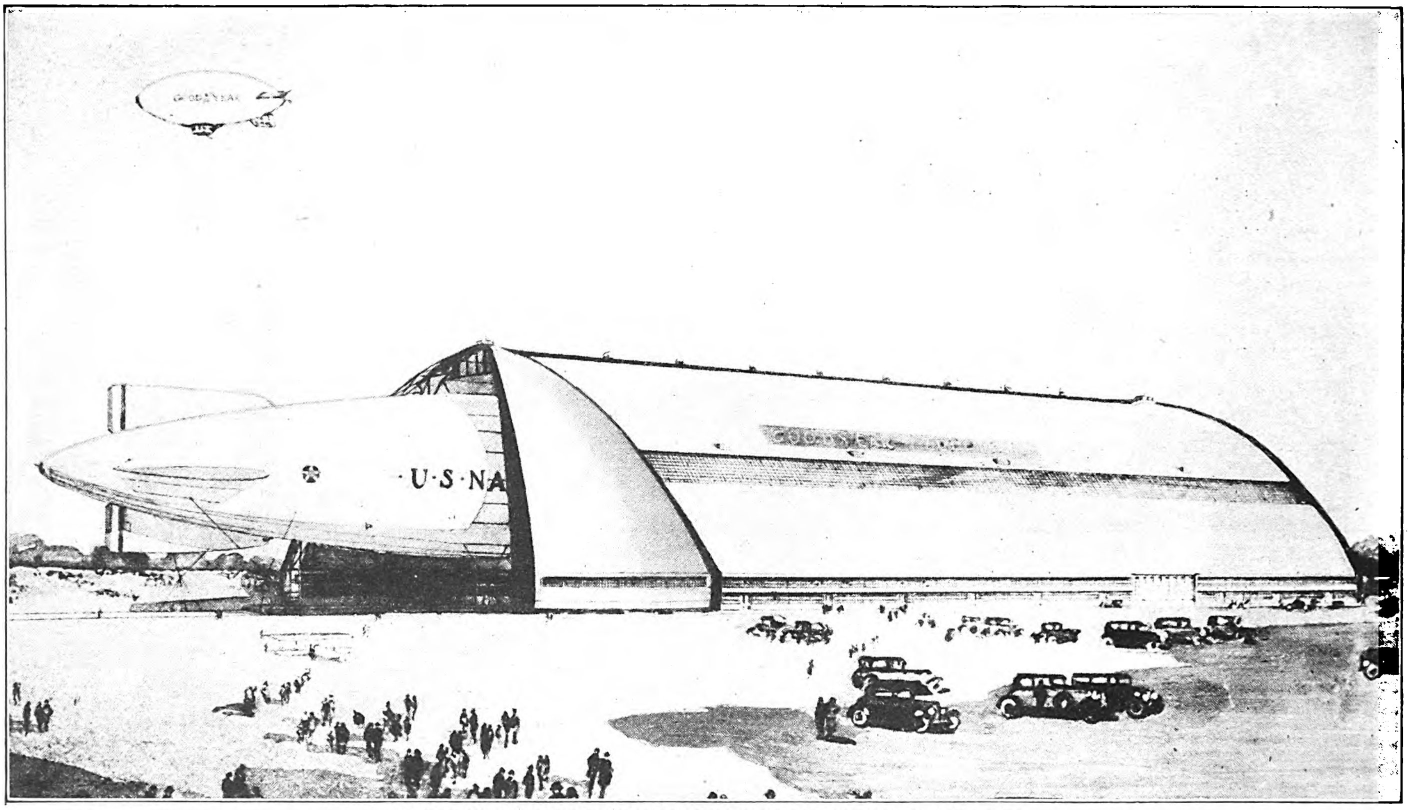
The creation of a corps of technical experts possessing qualifications as naval architects or constructors to pass upon the scientific construction of a ship has been recommended by Dickerson N. Hoover, Supervising Inspector General of the Steamboat Inspection Service. He revealed this plan in a radio talk from Washington, July 6, entitled "Protecting American Lives and Property on the Water." He would have the new corps established in his office.

"While it is true," said Mr. Hoover, "that today we conduct stability tests, these stability tests often penalize a vessel as a result of the ballast that must be provided as a consequence of the test. Much of this could be avoided, and also additional overhead in the cost of construction, if the plans of the ship were passed upon by the service before the ship is constructed. If that be considered too progressive, or a revolutionary idea, permit me to say that it is the practice that is today followed by the British Board of Trade."

Mr. Hoover stated that the plans of buildings are passed upon by municipal inspectors before they are constructed, and added that "what is logical in the construction of buildings is also logical in the construction of ships."

During the fiscal year 1928 more than 350,000,000 passengers were carried on steam vessels that are required by law to report the number of passengers carried; all of them were inspected by the service. Only 81 passengers lost their lives, while for each passenger lost, more than 4,000,000 were carried in safety.

"The Steamboat Inspection Service," Mr. Hoover said, "is striving hard for the zero mark, as a record in preventing the loss of human life on the water."



LARGEST STRUCTURE OF ITS KIND IN THE WORLD

The airplane carriers, *Saratoga* and *Lexington*, could rest, without their masts, side by side in the Zeppelin factory and hangar, of which this is an artist's drawing, now under construction at Akron. Its floor, 389,000 square feet, would hold six miles of box cars

The Zeppelin's American Home

Two World's Largest Zeppelins for Our Navy Will Be Built in Huge Hangar Now Arising at Akron, Ohio

By WALTER E. BURTON

ERECTION of the huge airship factory and dock in which the two Zeppelin-type Navy airships of 6,500,000 cubic feet gas capacity will be built is presenting a wealth of technical problems, the solving of which doubtless will prove of value to many fields of engineering. The building, situated at the southern end of the Akron, Ohio, Municipal Airport, will be the largest of its kind in the world. It has no pillars or other inside supports. It is to be, when completed, 211 feet high, 1175 feet long, and 325 feet wide. It covers eight and one half acres of ground.

Perhaps the most difficult—at least the most spectacular—phase of the building construction was successfully carried out recently when the central arch of steel webwork was raised into position. The feat attracted the attention of engineers in all parts of the world.

The two supports of the central span had been erected, each 100 feet high and 325 feet from the other. The problem was to raise the remaining portion of the semi-elliptical arch so that its base would rest on top of the towers. The weight of this span is 360 tons, its height being about 100 feet and its width at the base about 200 feet.

The two steel-beam supports having been completed, the remaining 360-ton span was assembled on the ground between them. At the top of each support, pulleys were placed, and over these, large steel cables were run. One end of each cable was attached to the portion to be raised, and on the other end was fastened a steel bucket containing scrap iron, the weight being about 36 tons. There were eight of these counterweights which served to reduce the weight to be lifted to about 72 tons.

FOUR railroad cranes with lengthened beams curved at the upper ends were placed so that one occupied each corner of the span. These cranes lifted the mass of steel into position, aided by the counterweights. But before this could be done, the tops of the supports had to be spread apart so that the center would slip into place unobstructed. Hydraulic jacks placed under a special falsework accomplished this.

On the day before the raising, the span was elevated five feet above the ground and allowed to rest there overnight, so that the cables would be drawn equally taut. At about 7:30 A.M. the following day, moving of the section into position was begun. Shortly after noon, it was being bolted to the supports. The intervening time had been spent largely in numerous conferences among engineers in charge, so that the actual time required to raise the arch was little over an hour. The work progressed without even a slight mishap.

It is significant that the Goodyear-Zeppelin Corporation had awarded contract for erection of the steel work of the factory to the American Bridge Company, for the constructing of one of the giant arches is very much like the building of a bridge. The engineer in charge of the work is W. C. State, consulting engineer for the Goodyear-Zeppelin Corporation. Plans for the arch, as well as for the rest of the building, were drawn by Wilbur Watson and associates of Cleveland.

The arch recently erected is the central one of a series of 13 which will support the sheet-steel roof of the building. Each arch weighs 620 tons complete. The middle one is permanently fastened to its foundations, the remaining ones being mounted on rollers. These rollers, operating on tracks which rest on concrete piling, will permit thermal expansion and contraction of the huge steel mass in every direction. There will be approximately one foot of change in the building length from the lowest probable winter temperature at Akron to the highest summer heat.

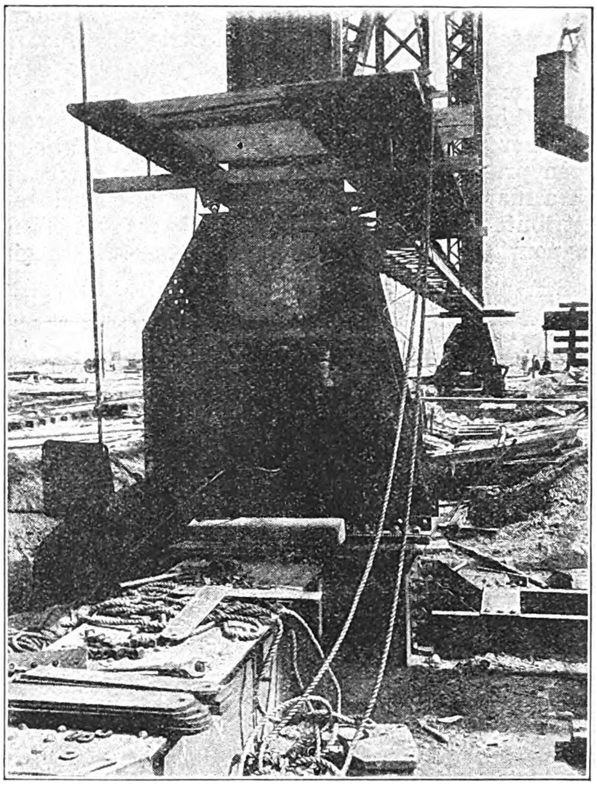
As soon as the first arch was in place, work was started on the six that will stand to the south of it. It is the plan of engineers to erect the southern half of the factory and dock first, so that assembling of the first of the giant airships can be started at an early date. Construction of the airship and its home will then proceed simultaneously. One new arch will be put up every three weeks.

But erection of the steel arches is not the only bit of difficult work connected with building the world's largest airship shed. Preparation of the ground, for example, was a considerable task.

The building is located on one of the best dirigible landing fields in the country, according to acknowledged experts. The land is nearly level, and is surrounded by a ring of low hills, so that the Zeppelin factory will lie in the center of a huge saucer. This is of importance because such conditions tend to produce even air currents.

The building site is in the midst of a swampy area through which a small stream once ran. This stream was diverted into a large sewer placed beneath the building. In order to bring the building space and the surrounding airship handling area up to grade, the marshy ground was removed—in some places to a depth of more than 2 feet—and solid material was filled in on top of the clay that was underneath. The fill averages 5 feet in depth, and was rolled every 9 inches. Over the eight and one half acres of floor space—an area approximately four city blocks long and one wide—a layer of slag 6 inches deep will be placed, and on top of that a concrete floor reinforced with wire mesh will be laid. This floor must be perfectly level because it will be used as a fixed plane from which to make measurements on the airships to be constructed.

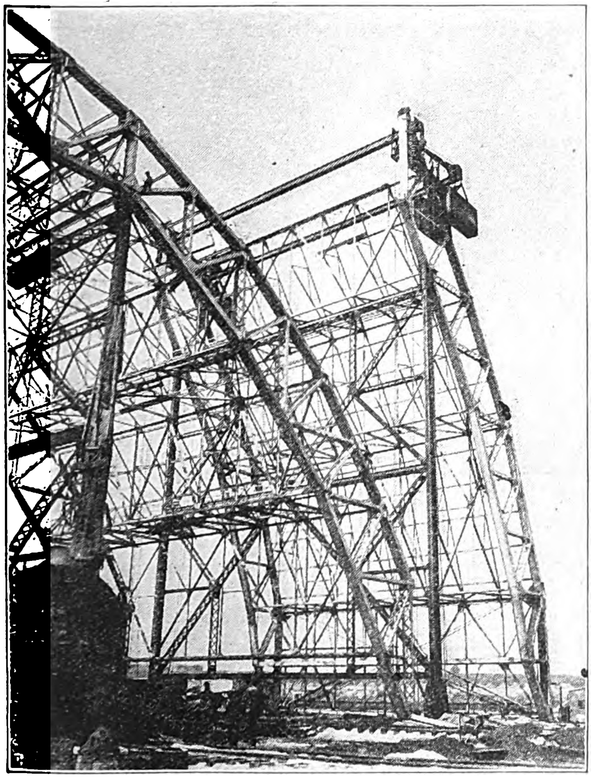
Before work was begun on the factory, it was necessary to lay off a line exactly 1200 feet long, from which all measurements could be made during the course of construction. But since 500 men measuring such a line would each return with a different result, it was necessary to exercise great care in making the measurement. A tested tape was obtained from the United States Bureau of Standards, and was used in establishing the base line. Compensation was made for temperature variations. So accurately was the measurement made that parts of the steel arches, with pre-drilled rivet holes, fitted together exactly, without any trouble.



FOR SPRINGING SIDE MEMBERS

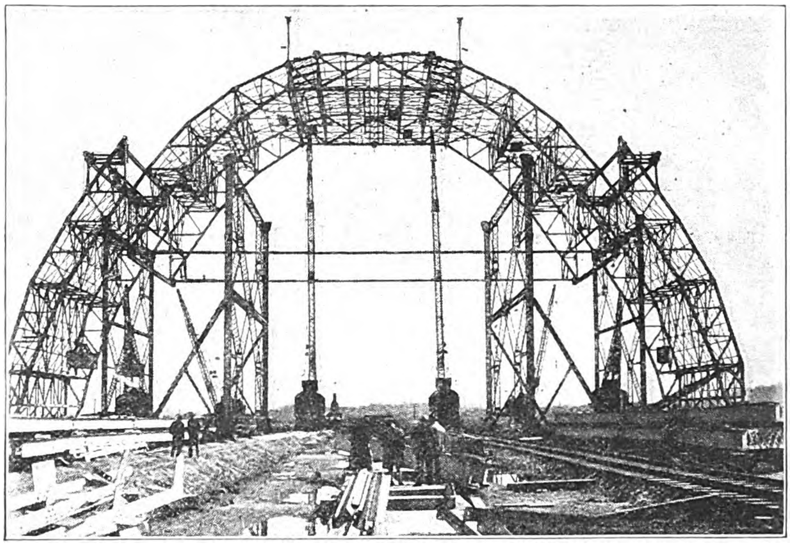
Hydraulic jacks under this falsework spread the tops of side supports so the central span could move into place

Grading of the ground, driving of 1300 concrete piles, and pouring of much of the concrete base for the arches, door tracks, and docking rails was done in the winter, with the temperature below freezing most of the time. By carefully heating the concrete before pouring, then covering it and keeping it above freezing by oil



READY TO BE LIFTED

An arch span assembled on the ground. Falsework—vertical beams—for spreading side members are shown

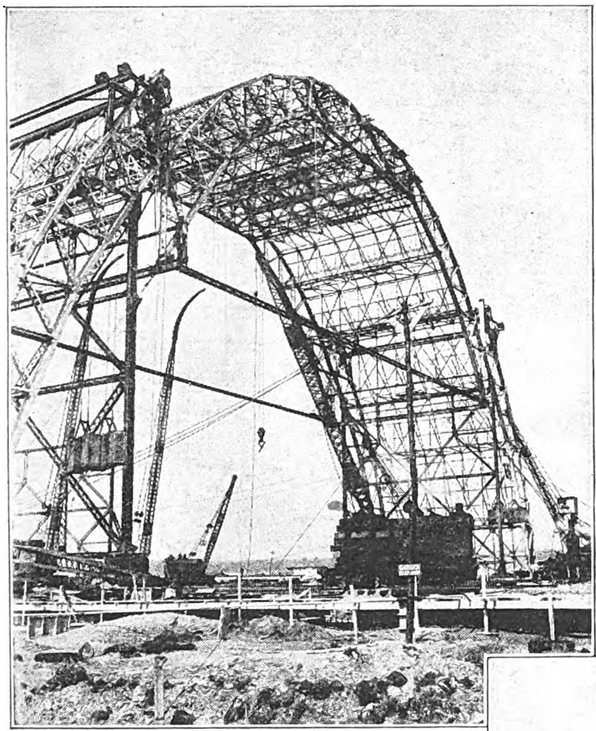


360 TONS GOES INTO POSITION

Southern side of the hangar's first arch as the central section nears its final position. Falsework for this arch and for the second one may be seen here fires beneath the covering, none of the material was frozen.

Bedrock is 30 feet below the ground level. The piles, averaging two dozen beneath each arch leg, were driven to this level. In all, 12,000 cubic yards of concrete will be required for the building, and most of this will be below the ground level. A nine-foot concrete tunnel containing electric, water, air, steam, and other lines will run from one end of the building to the other.

Concrete work for the structure has been pronounced the finest ever used on a major construction job. This is attributed to the great care exercised in pouring and in regulation of temperature while the material set. The concrete masses forming the side foundations are tied together by steel and concrete girders and beams running underground, from side to side of the dock. This bracing will prevent spreading of the foundations under the thrust created by the steel above.



In order to handle airships nearly a fifth of a mile long, a large, unobstructed, level space is required. To obtain this, many acres of land in the vicinity of the building are being brought to grade. For filling, earth from nearby hills is being used, the hills being leveled and the swampy area raised simultaneously.

Visitors to the factory site during the first months of operations have noticed numerous little mounds of earth covering several acres near the building. This is top soil that is being saved for covering the operating area. Turf is considered the best surface on which to handle dirigibles, and grass will not grow readily in excavated soil. Hence the saving of the fertile top layer which will later be spread out.

Extending through the hangar and for 1600 feet beyond each end will be docking rails resting on concrete bases. Over these rails will run cable cars which will serve as mobile anchors for the airships, easing them into and out of the dock.

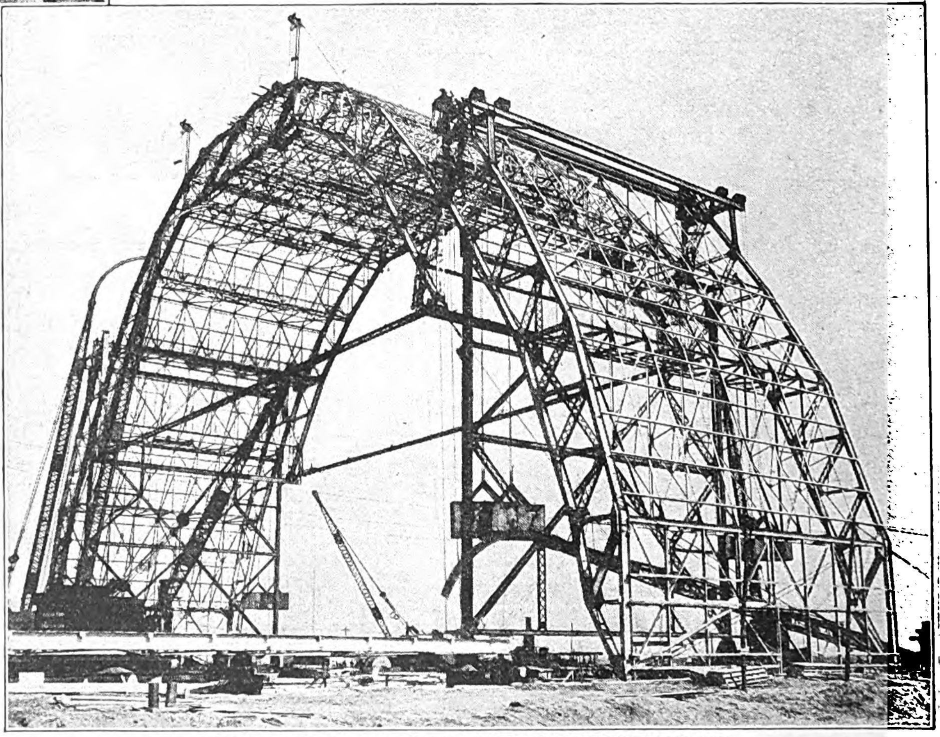
Such a huge structure as the Zeppelin factory and dock suffers a tremendous stress when subjected to varying wind pressures. In order to minimize this force, the entire building has been designed to present only curved external surfaces. In cross section, the structure is semi-elliptical. For the first 27 feet the walls rise vertically, then begin to curve inward.

These curved sides are being built to withstand a calculated wind pressure up to 200 pounds per square foot. This is five times the maximum figure for ordinary industrial buildings. Bracing the steel shell to endure such a tremendous stress was not the least of the engineering problems involved. Effective pressure induced by air currents on the outside is reduced by shaping the building so that practically all surfaces are presented to the wind at an angle. But it was found that, when wind of even ordinary velocity blows over the building, there is created a vacuum on the lee side. If the wind speed is high, approaching hurricane proportions, steel plates on the building might be ripped off if they were not properly fastened, or the building might burst from pressure within if the bracing were inadequate. Therefore, the structure was designed so that its members can withstand a stress arising from air pressure both inside and outside.

Doors provided one of the biggest problems. It was necessary to develop a method of opening and closing practically the whole of each end within a short period of time. To accomplish this, "orange peel" doors were designed. As their name indicates, these doors resemble portions of an orange peel, each section representing one eighth of the entire peel.

BASES of the sections rest on electric street-car trucks running on circular tracks. There are 10 trucks for each section, supporting a weight of 1,500,000 pounds, or 750 tons. From the closed to the open position, the trucks travel approximately a quarter of a circle at a speed of 40 feet per minute. Five minutes will be required to open or close the doors at either end of the building.

There are no hinges other than huge steel pins at the apex. Each of these pins is 4 feet long and 17 inches in diameter. All electrical equipment is to be provided by the General Electric Company. Alternating current motors developing 200 horsepower each at 600 revolutions per minute are specified. Gears driven by the motors engage in racks on the outer surface of each door. After such a huge mass of



TWO VIEWS OF THE RAISING OPERATION

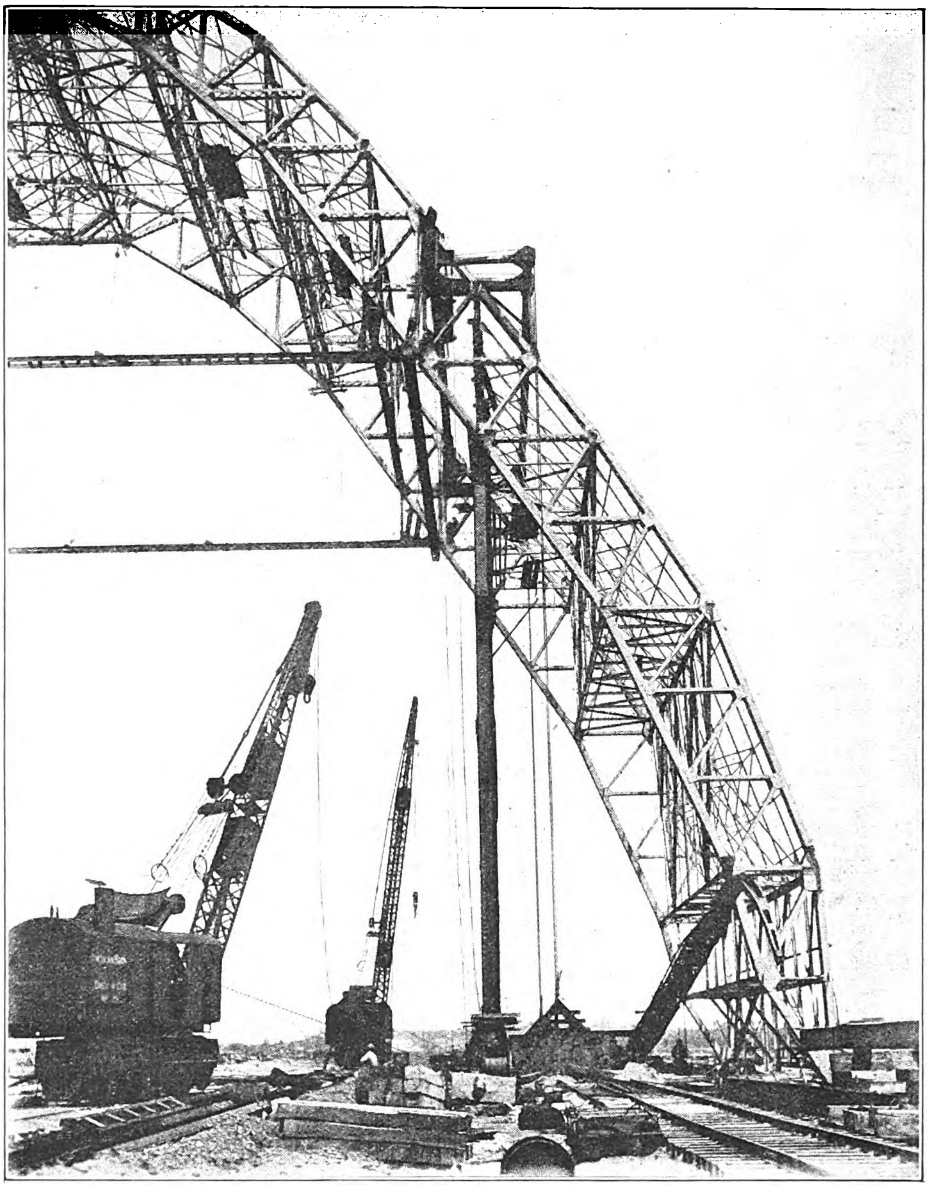
Counterweights did most of the work of raising the central arch span. These, the straight arm cranes, and the curved arm cranes which assisted, may be clearly seen in these two illustrations. Below, the span is within 20 feet of the top and counterweights are down steel has been set in motion, it cannot be stopped without the exertion of a tremendous counter-force. Electro-hydraulic brakes accomplish this.

The orange-peel doors are designed so that they will set up a minimum of air disturbance when open, closed, or in intermediate positions. When fully opened, they rest against the sides of the building, producing no greater air disturbance or offering no greater wind resistance than when closed.

The skeleton of the airship factory and dock will be covered with a corrugated sheet steel. Contract for this part of the job has been let to the H. H. Robertson Company of Pittsburgh. However, ordinary corrugated steel common to the building industry for many years will not be used. Instead, a material in which the corrugations are more nearly V-shaped in cross section, instead of the conventional curved form, will be used. In building airship sheds at Scott Field, Illinois, Cardington, England, and Karachi, India, the Robertson Company has developed this special corrugated material.

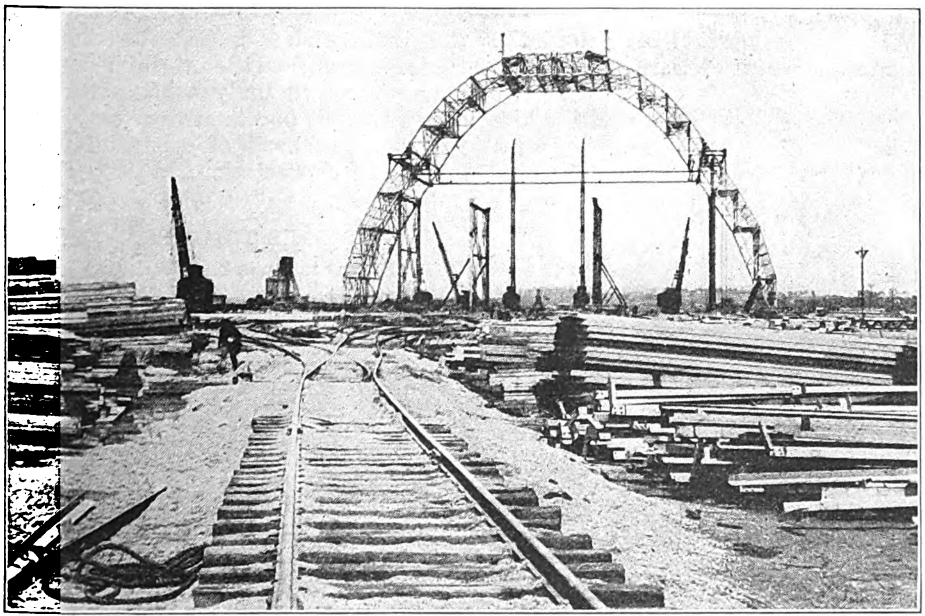
No paint will be used on the outer surface of the steel plates. Instead, a coating of asphalt and asbestos, covering each individual sheet, will be employed. This protects the metal beneath from all forms of corrosion, and will tend to minimize moisture condensation on the interior of the building by providing for a gradual change in temperature. Such condensation might be detrimental to dirigible fabric.

The Zeppelin factory and dock, which has made Akron the center of America's lighter-than-air craft industry, is an excellent example of the frequently-made observation that, when modern science produces a huge machine, it must produce something a little bigger to house it. The building is constructed so that an unobstructed floor area will occupy nearly all of the interior, the remainder being taken up by shops and other rooms on either side. The space is great enough to house an airship of 10,000,000 cubic feet gas capacity—more than twice as large as any now in existence—providing it is built on a six to one ratio of length to breadth. Workmen will reach parts of an airship being built or housed, by means of "cat walks" running from one end of the building to the other, by stairways, and other devices.



THE ARCH CONNECTION IS MADE

After anxious moments had passed, the first arch was fitted in its place after being raised in the unique manner described here. The counterweight arrangement and the joint are shown



Copyright, Walter E. Burton

ONE ARCH UP, 12 MORE TO BE ERECTED

The first arch of the factory-hangar in place. Twelve more will be erected—six on each side. The footings of this one are rigid but the others will be on rollers to take care of expansion

The Zeppelin plant is scheduled to be completed sometime in 1930. Construction of parts and testing of materials already have begun at the present Goodyear-Zeppelin plant a mile away. A minimum of perhaps 600 men will be employed for about three years in building the first navy dirigible.

Steam Stages a Come-Back

Question of Steam versus Hydro Generation of Power is Being Answered by Improvements in Steam Power Equipment

By R. M. BOYKIN*

It's Time for Facts

SO long and so speciouly have the words "white coal" been conjured with that the man in the street has been deluded into believing the water-power conjurer can continue indefinitely to draw cheap electricity from our water power resources. To the man who simply pays to see the bag of tricks, the conjurer can extract from the hat as many live rabbits as he desires.

It is significant, however, that in the Pacific coast states the trend is toward steam generation although in that region there is sufficient undeveloped water power to supply the region's electricity demand for many decades to come. Why? Because, as Edison recently said, electrical power can now be generated cheaper by steam than by water power.

In industrialized America, the man who pays the bill, the man who is called upon to elect a politician on the basis of his white coal development promises, and the investor, large or small—all are vitally concerned in this probem of generating electrical power. It's time they should have facts. The accompanying article gives them.

—The Editor

ALMOST any morning of the year from November first to All Fools' Day, the visitor to the Pacific coast can see monstrous banks of fog sweeping in from the ocean, covering the land like a soggy blanket. Westerly winds carry this murky mass of ocean moisture to the cold peaks of the Cascades and Sirerras where it is precipitated as rain or snow. Down the mountain sides the water hurtles, over precipices, through canyons, and back to the ocean in endless grandeur.

Contemplation of this cycle is inspiring, indeed, to the lovers of Nature's beauties, but it is also hailed as a source of great wealth by practical men who visualize the harnessing of this stupendous amount of water power to serve the needs of man. A travesty it is that this gift of Nature should become a political football for demagogues. Those who aspire to preserve the beauty of this unperishable resource will soon have nothing to fear; power companies, with almost half the undeveloped water power of the nation at their very elbows, are turning to their first love, the steam generator, and so-called nature conservationists may learn that, like many a woman, their pet protégé possesses little more than the fatal gift of beauty!

But what about the failure to utilize the millions of horsepower in undeveloped water power sites of this country? What about exhausting the diminishing supply of fuel? Here the rabid conservationist is given another bone to chew!

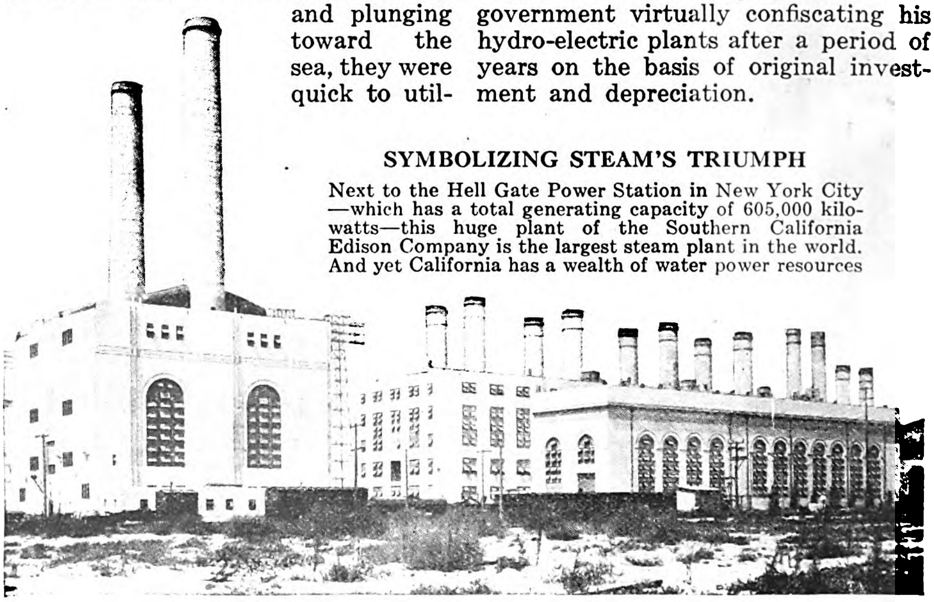
There is an indefinable romance and lure in the magnificant rush of a giant river over a wall of rock. "Endless 'white coal' that may be had for the taking," is the popular illusion. What a wonderful wealth of cheap power! Whether it be the gracefulness of Multnomah, or the grandeur of Niagara that appeals to the senses, there is ever-present the thought of "power" and the reflection on the wastefulness of its energy. And this conception is not altogether ill-founded.

IN theory, at least, all our power sites should be harnessed before our more perishable resources—such as wood, coal, or fuel oil—are used. But practically the problem is not so simple, and that is a factor that the conservationist has overlooked. It begins to appear as though his eternal vigilance of this treasure chest of Nature has been unnecessary, for the inventive genius of the engineer has brought the steam plant back into the picture as a formidable competitor of the hydro-electric plant in the production of electricity, and the guardians of "white coal" may find themselves holding an empty sack!

When the miners of '49 found the mountain streams of California diving and plunging toward the sea, they were quick to utilize the power at hand. Giant nozzles were used to tear down the gold bearing gravels of the valleys, and it was but a single step to put the high pressure jet to useful work against a series of buckets attached to a wheel. This wheel at first was belted to various types of mechanical equipment, but later was directly connected to the first crude type of electric generator, and with the success of this contrivance, the engineering world saw the birth of the hydro-electric industry. Today, the 559 hydro-electric plants near the western border of this country have reached almost the acme of mechanical perfection.

As might be expected, there were some abuses in the early stages of development. Then came federal and state regulation, culminating in the passage of the Federal Water Power Act in 1920. The intent of this regulation may be praiseworthy, and certainly many aspects of it are beyond reproach, but there are many drastic provisions that promote a miserly hoarding of resources. Why this tying up in a napkin the gift bestowed on us so bountifully by Nature? Why encourage the burning of diminishing fuel, while the endless cycle of power in rain and rivers may soon go begging for bidders?

FOR example, the recapture clause of the Federal Water Power Act alone is sufficient to throw a scare into the hard-headed business executive. He is loath to face the possibility of the government virtually confiscating his hydro-electric plants after a period of years on the basis of original investment and depreciation.



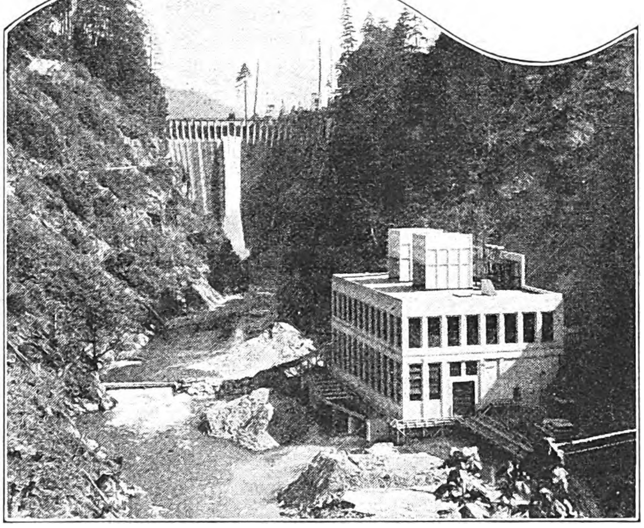
SYMBOLIZING STEAM'S TRIUMPH

Next to the Hell Gate Power Station in New York City —which has a total generating capacity of 605,000 kilowatts—this huge plant of the Southern California Edison Company is the largest steam plant in the world. And yet California has a wealth of water power resources

---

*See "Among Our Contributors," page 197.

And the issue is a vital one. Of the 55,000,000 horsepower available in the streams and rivers of the United States, only about 12,000,000 horsepower has been developed for the production of electricity. And the use of electricity in homes and in industry is increasing by leaps and bounds. In our company, alone, the demand for "juice" for homes has increased from 401 kilowatt-hours to 763 kilowatt-hours since 1922. During the last decade the use of electricity throughout the nation has practically doubled. To this fact may be credited much of our national efficiency and prosperity. The comfort of almost every little home and hamlet has been enhanced by electric light and electrical labor-saving appliances.



THE ORIGINAL COST COUNTS

The Baker River plant, Puget Sound Power and Light Company, cost 7,000,000 dollars and was three years in building

If 30,000,000 horsepower were to be generated by steam instead of water, the consumption of coal in modern stations operating on a 50 percent load factor, would be a hundred million tons per annum. At an average cost of four dollars a ton at the boiler, the annual loss from burning coal and wasting water would be 400,000,000 dollars.

BUT the hand-writing on the wall may be read. With unprecedented wealth of water power at our very door, the power companies of the Pacific slope are definitely turning to steam as a source of electric light and power. Our company, the Puget Sound Power and Light Company, is just beginning the construction of a 5,000,000-dollar steam plant on Lake Washington, which will eventually generate as much electricity as is now produced by its hydro-electric stations. In Southern California, the Edison company, alone, has put in service over 400,000 horsepower of steam plants since 1924. At the present time this company has 588,000 horsepower of hydro-electric plants but when the new unit is completed in 1929, it will have 550,000 horsepower of steam with no increase in water power.

The Great Western Power Company of California is at present installing some 50,000 horsepower in steam, making a total of 92,000 horsepower of steam for this company. About 50 percent of the horsepower developed by the San Joaquin Light & Power company is from steam, and almost the same percentage holds good with the Pacific Gas & Electric Company.

And this in an area normally considered to be a hydro-electric stronghold! But bare facts are tedious, although surely they accent the fact that steam has come to stay and to compete upon an equal, or even a favored, footing against water power!

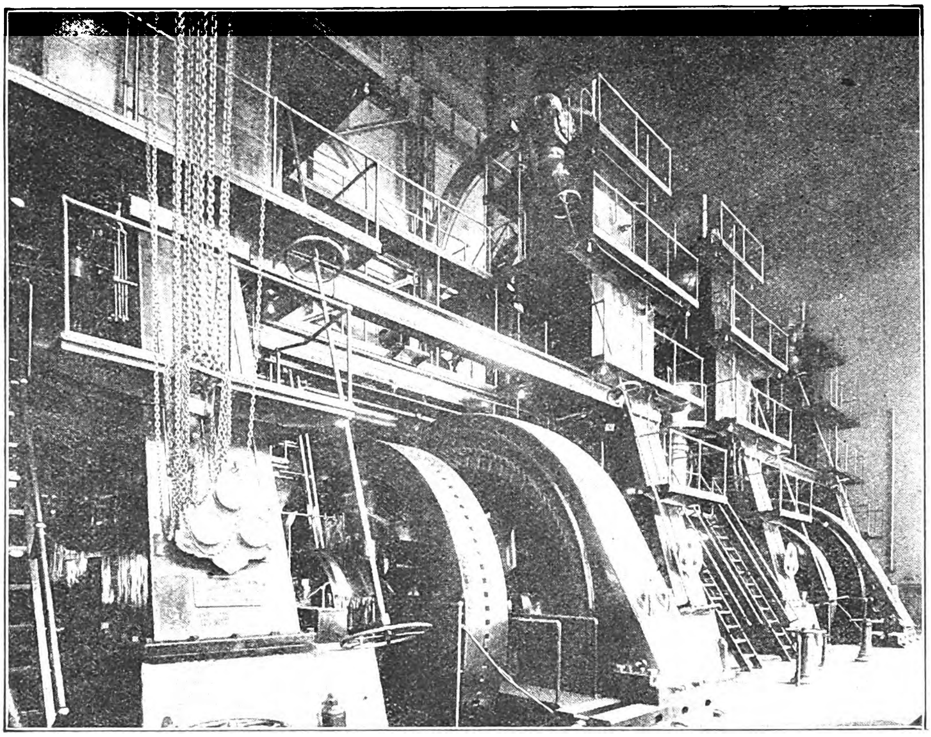
Hydro-electric developments are never a matter of easy exploitation. Aside from the barriers of legal restrictions and regulation which are difficult enough to hurdle, many are the added problems to solve. The excessive values that some individuals have placed on undeveloped water power sites, the difficulty of power companies to purchase such public lands, demands for imaginary damages to lands used for power purposes, and many other similar obstacles must be taken into consideration on every proposed hydro plant. Aside from these difficulties, long periods of time must elapse in order to make proper studies of stream flow and, because of the seasonal and annual variations, it is extremely necessary to take flow records over several years. The value of a hydro-electric plant depends largely on the amount of water available and this must be pre-determined carefully, before a proper analysis can be made. Then, too, geological and topographical conditions must be carefully studied; and when a definite conclusion is reached, the power demand may not be suited to the plant proposed.

THERE are likewise other difficulties confronting the engineers who must plan the construction of a hydro plant. The construction period is usually two or three times as long as that for the steam plant. Where a hundred thousand horsepower steam plant can be designed and put in operation in less than a year, a similar hydro plant might take from two to three years, depending upon its complexity. If long rock tunnels, high dams, difficult foundations and inaccessible country are involved—which is usually the case—the problems take months to solve. This ties up capital for a long time without return. Furthermore, the original investment in a hydro plant is several times that of a steam plant of equal capacity. If the hydro cost per horsepower is more than a predetermined amount, the interest on the indebtedness may well be more than the cost of operating a steam plant, including fixed charges, fuel, and labor.

Then consider the stupendous cost of long transmission of high voltage current from the mountain recesses to centers of population, wider right-of-way, and costly transformation and distribution of the hydro-electric output. Furthermore, the initial construction of a hydro plant, such as the dam, water tunnel, and so on, representing by far the greatest investment, must be completed at once regardless of whether or not the entire power available is needed. Unlike a steam plant, this part of the hydro plant cannot be built in units, as needed, and therefore the investment is often far out of proportion to the available market for the electricity produced.

THE steam plant is a mere child's toy by comparison. In the first place it involves no cumbersome regulation. Any location with rail or water transportation, near the center of population, and close to a water supply for condenser purposes, will usually make the site easy to find. A plant whose storage reservoir is a coal pile does not have to fear a lack of rainfall during the summer months. The steam plant is usually located at a point close to the load center, and this greatly simplifies transmission line problems. Because of the short distance that power must be transmitted, low voltage can be used, and this fact again simplifies switching and transformation.

But the real crux in the come-back of steam in the generation of electric energy is the vast improvement in equipment of the steam plant. Although there has been few marked changes in the hydro-electric plant during the last 20 years, the modern steam plant of today is as different from that of a few years ago as day is from night. A station operated by the Edison Electric Illuminating Company of Boston produces energy for less than a pound of coal per kilowatt-hour. Another station in the same city, built by the same firm 10 years earlier proudly boasted a record of 1.75 pounds of coal per kilowatt-hour. The U. S. Geological Survey reports that the national average since 1919 has been reduced from 3.20 pounds per kilowatt-hour to 1.83 pounds per



TWO OLD TIMERS THAT GENERATE 3500 HORSEPOWER

These reciprocating steam engine generator units, owned by the Puget Sound Power and Light Company, are so bulky that they occupy as much space as a 100,000-horsepower turbine

kilowatt hour—a remarkable showing in just a few years! The conservation of the nation's coal through increased thermal efficiency in electric light and power plants, as compared with 1919, is 5 percent of all coal used each year in the United States.

At the time the hydro-electric plant reached its present high state of efficiency, the steam engine was still of the cumbersome reciprocating type, with huge cylinders and pistons. The machines were ponderous and slow moving, and occupied an extensive floor area. Boilers were small in size and stoked by hand, of low pressure, and with practically no super-heat. Electric generators were belted to the engine, and the result of all this was that efficiency was low and power cost high.

CONSEQUENTLY the super-power age of today was mothered by hydro-electric plants, rather than by steam. But the tide is turning to steam power. There came a time when an engineering genius discovered that a jet of steam could be used just as well to play on a wheel blade as could the giant water nozzles of the hydraulic mining days of California, and the steam turbine became a reality. By substituting rotating for reciprocating elements, it became possible to use higher steam pressures, greater speeds, and therefore smaller units to produce more power. From that time on, the development of the steam turbine has been rapid until it has now reached a point where the water turbine must look to its laurels.

The steam boiler of today seems to have limitless possibilities. One of the largest in the world today, that in the Edison company plant at Long Beach, California, stands 65 feet high, the equivalent of a five-story building.

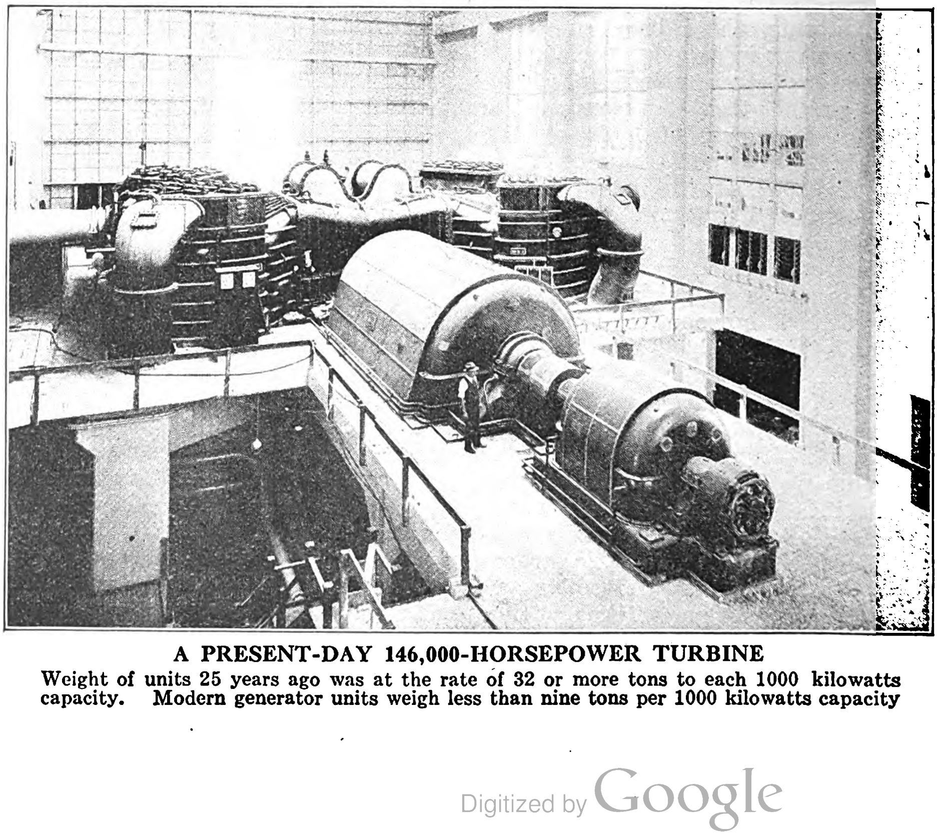
There are very definite limits to the ability of water power to compete with steam power in the present state of the art, notwithstanding the fact that our huge water-power systems have almost reached the acme of perfection so far as efficiency is concerned, and super-power steam stations are approaching that point. For that reason, steam stations are increasing in size and output at a greater rate than hydro-electric stations, and unless many water-power sites are developed at once, they may not be developed for many years to come, if at all—at least not until there is a fuel famine. And according to authorities, among them the United States Geological Survey, there is in sight at present enough coal to last many hundreds of years.

Yet, there is a persistent popular notion, fostered by unreasoning demagogues, that any waterfall can be converted hydro-electrically into a never-ending stream of gold. Too late, perhaps, they will learn that all is not gold that glitters, not even the sparkling spray of a Niagara, the scintillating orations about Muscle Shoals, or the visionary Utopia of Boulder Dam.

Moved solely by the pressure of economic forces, it is significant that in the decade from 1920 to 1930 it is estimated that the increase in water power will total only 5,960,000 horsepower, whereas steam during the same period, will show a total increase of 13,225,000 horsepower.

JUST the saving of a few more heat units, a few more refinements in the turbine—and both of these are already in sight—and the cost of steam-generated power with the present price of fuel, will be less than that generated by hydro. Today the two plants are practically equal and only the highest technical skill can determine which of the two would be the more economical for any given condition.

Under proper encouragement and sympathetic regulation by the state and nation it should be possible to continue to develop our power streams for some years but, from this time forward, the developments will be carefully planned.



A PRESENT-DAY 146,000-HORSEPOWER TURBINE

Weight of units 25 years ago was at the rate of 32 or more tons to each 1000 kilowatts capacity. Modern generator units weigh less than nine tons per 1000 kilowatts capacity

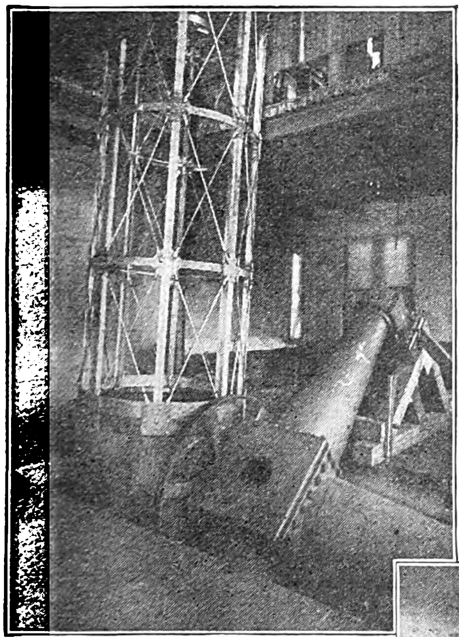
Designing Large Telescopes

A Suggestion of the High Engineering Refinement Involved in This Highly Specialized Problem

By J. W. FECKER
Optical Engineer

TO-DAY'S telescope, perfectly balanced and as nearly perfect as may be, represents the outcome of a series of problems in engineering which, before a single piece of material is actually worked, the engineer studies out, prepares, and modifies, until perfection of design is reached by means of the application of related sciences such as mathematics, optics, electricity, metallurgy and foundry practice, and mechanics. Thus the finished product functions from the start. It comes also within the required limits of tolerance, which are very rigid.

Some idea of the main problems involved in creating such a telescope may here be given. The goal sought is to obtain a mechanical mounting to hold the optical parts in a fixed and unvariable alignment, so that the whole unit may be pointed readily to any part of the sky, and any desired motion maintained without interruption due to irregular driving or shifting of any part.

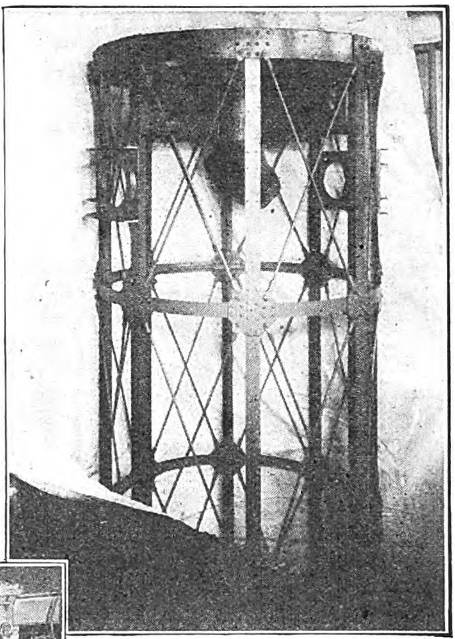


FOR SOUTH AFRICA
The new 60-inch reflector designed and constructed for the large Harvard South African observatory near Bloemfontein

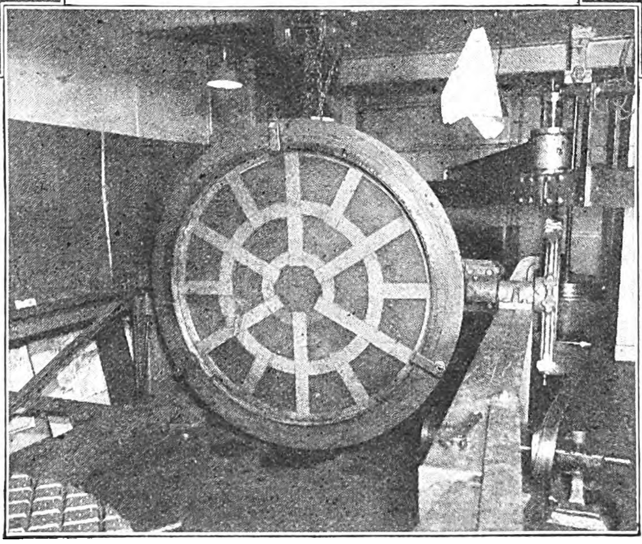
When the design is completed, the remainder of the problem rests with the working staff. Its members should be, and for the construction of the 60-inch telescope illustrated in these pages actually are, highly skilled mature men of long experience; men with character and balanced temperament, each doing his portion of the work, under adequate supervision, with extreme skill. To these and other faithful workers of the same sort everywhere a word of praise for their efforts is due.

THE author of the accompanying article is a foremost professional designer and builder of large telescopes. With his father, the late G. L. Fecker, he was for many years engaged in much the same work for the famous firm of Warner and Swasey of Cleveland. During this period were built the mounting for the 72-inch reflector of the Dominion Astrophysical Observatory, Canada; a 36-inch reflector for the University of Arizona; and a 60-inch reflector for the Argentine National Observatory. The 60-inch reflector for the Ohio Wesleyan University was designed by the author at the time mentioned and the disk for its mirror, cast at the Bureau of Standards last year, is now in his shops at Pittburgh being prepared. Recently he made a 30-inch reflector for an amateur, Mr. H. C. Gibson, of Philadelphia, and a 24-inch photographic refractor for Harvard. The present article was written around the new 60-inch reflector for Harvard's new South African observatory, being finished at the present time in the Fecker shops. Mr. Fecker is the successor to the noted John A. Brashear.—*The Editor.*

Turning now to the materials: The optical system of a large telescope is made up of a number of lenses or mirrors, or a combination of both. The material for the lenses and mirrors must be most carefully tested for uniformity of annealing and, in the case of lenses, for uniformity of index of refraction. Following these preliminary tests the curves of the glass are mathematically computed and the lenses ground, polished, and centered. In this stage they are about 25 percent complete, and have yet to be figured. This is the final and most difficult part of the optical work. As a rule the tests before final polishing will show aberrations. These are corrected, and the surface curves are perfected by means of small hand-polishers—entirely a matter of skill and experience on the part of the person doing it, no mechanical contrivance being yet known.



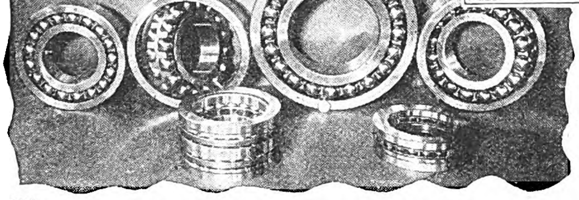
UPPER END OF TUBE
Showing adapters to hold accessories and the cell of the diagonal Newtonian secondary mirror at the center of the tube



THE FIVE-FOOT DISK OF GLASS
In the polishing machine, but temporarily tipped up for testing. Note spiderweb supports visible through glass; also the polishing lap visible in the lower corner

The errors to be eliminated in the final hand polishing are so extremely minute that the usual changes of temperature in a room would introduce errors 10 or 20 times as large. Therefore a "constant temperature" room is an important aid. In it the glass is allowed to stand many hours after each working, in order that a reliable test may be obtained. When it is realized that merely placing the warm hand on a large glass optical surface for a few seconds will cause enough local expansion at that area to be visible to the delicate test four hours afterward, an idea may be had of the accuracy required in working such optical surfaces.

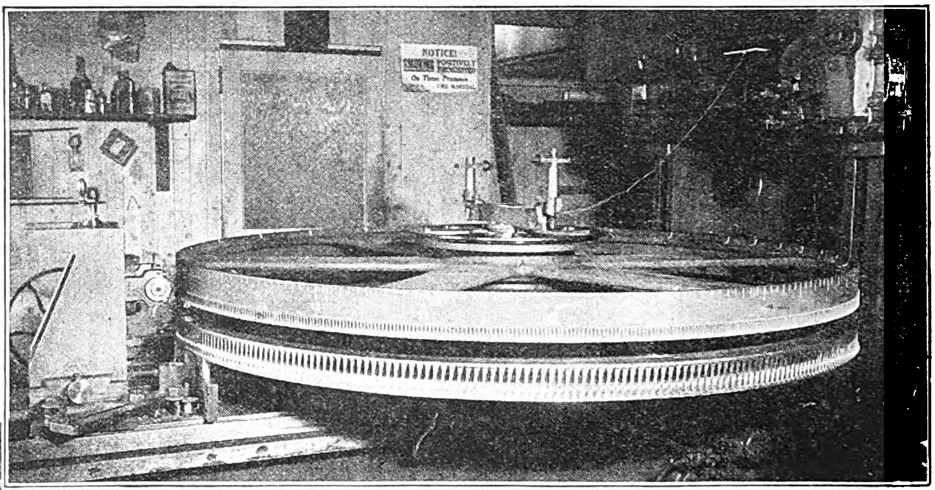
A good reflector mirror is made to an accuracy of better than one tenth of a wavelength of sodium light, or better than one 500,000th of an inch. With very long focus lenses or mirrors the accuracy required is very much greater; and it increases with increased sizes. There is also the problem of a lens or mirror bending due to its own weight. In every large piece of glass a measurable bending, even when the thickness is as great as one sixth the diameter, is inevitable. In the 60-inch Harvard telescope just completed, the mirror was successfully supported and worked in such a way as to overcome this bending when in use, notwithstanding that the glass disk is not as thick as one-sixth the diameter. The differential expansion of the glass and the cell in which it is placed must be guarded against, where temperature ranges are present, between the 100 degrees or more of a midsummer day and 20 or 25 degrees below zero of midwinter.



LARGE BALL BEARINGS

For polar and declination axes of the 60-inch reflector. For scale of size note watch against the largest bearing

AS the sizes of telescopes have constantly increased, the photographic telescope has rapidly come to the foreground, particularly the photographic reflector. There are two reasons for this. First, by the use of photographic plates and long exposures it is possible to record details accurately which the human eye could not see, even with the largest of telescopes. As the photographic plates are handled by a skilled observer, he is able to expose and record faster than observations could be made by visual means. Measuring the plates can readily be done by members of the observatory staff, giving the astronomer more time for the development of new theories from the plates. Second, since the disk required for the objective lens of telescopes becomes more difficult for the glassmaker to produce, in proportion to its increase in size, the cost of the raw disks for refractors becomes practically prohibitive; whereas, for the disk of the reflecting telescope the only requirement is uniformity in annealing. There is no effect on the image of the reflector because of variation of index of reflection, fine striae or bubbles in the glass. Again, the reflector involves a purely front surface refraction; there is therefore only one surface requiring optical figuring on each element.



CUTTING THE 8-FOOT WORM WHEEL

The tolerance permitted is only 1/25,000 of an inch. Any mechanical engineer or skilled mechanic knows what that means in the way of super-refinement

For these reasons, among others, a photographic reflector can be made about four times as large as a photographic refractor for the same financial outlay. Probably this is why work among skilful amateurs in making reflectors has been going forward with such an interesting and lively impetus.

In the mechanical mounting, the axes and tube are computed for minimum deflection. In designing the optical system through calculation, the maximum misalignment which can be tolerated without affecting the image, is determined. This is usually of the nature of five to ten seconds of arc, but may be less, depending on the type of instrument. The tube is designed to have a maximum deflection not to exceed 80 percent of the tolerance. Actually, in the tube of the 60-inch Harvard reflector this tolerance is 0.0096 inch in a length of 19 feet 4 inches; the diameter of the tube being five feet nine inches. This small deflection is obtained by the use of heat-treated duralumin tees, angles and tie rods; also duralumin in all parts of the support mechanism.

The optical parts weigh approximately 2000 pounds, and the tube about five and a quarter tons, making the total weight of tube with optical parts six and a quarter tons—all perfectly balanced about the declination axis.

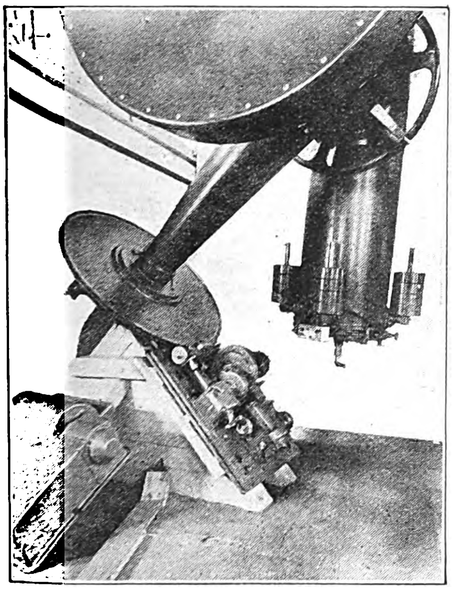
Axes sufficiently heavy to carry such a weight with minimum deflection, weigh another six and a half tons. The driving worm wheels and circles, and declination sleeve, bearings, and worm wheel housing, add another five tons. This is comparatively not a very large telescope, but the figures stated may give some idea of the weights which must be moved with absolute accuracy and control.

IN moving such weights in astronomical engineering, two problems present themselves. First, to move this mass of metal and glass at an absolutely uniform rate, exactly at the speed of the earth's rotation; second, to start and stop such a mass without jar, vibration, or surge, so that the most accurate setting can be made with certainty every time. The solution of the first problem lies in the proper choice of bearings and accuracy in the driving mechanism.

In practically all the large modern mountings, self-aligning ball bearings are used throughout on the axes for both radial and thrust bearings. A ball bearing is more sensitive in its operation than a roller bearing of equal size. Self-aligning ball bearings are used in order to allow movement of the upper or lower end of the axes, thus placing the polar axis exactly parallel with the earth's axis. These bearings are enclosed in oil-tight and dust-tight housings. Thus there is no exposure and practically no wear over an indefinite period of time.

The driving mechanism may be either by properly synchronized electric motor, or by a pendulum-regulated weight-driven clock. Either drive may be operated by means of a final worm driving a worm wheel held fast to the polar axis. In large telescopes the main worm wheel is usually between seven and nine feet or more in diameter and has 720 teeth cut in its bronze rim. The driving shafts, gears, worms, and worm wheel must be free from any errors of eccentricity or spacing of the teeth. Where there are several gears and shafts in the clock and worm drive, there is a possibility of a periodic building up and neutralizing of all the minute errors, producing a periodic driving error in the telescope. This would be very detrimental to the observer's "astronomical" well-being and to the results obtained.

In large photographic telescopes, in the Cassegrain combination, equivalent focal lengths as long as 100 feet are frequently employed, and a drift of the star image from the cross wire of as much as one thousandth of an inch can readily be detected. Figuring back, then—one one-thousandth of an inch deviation in 100 feet radius is produced by one twenty-five thousandth of an inch error at a radius of four feet. This is therefore the maximum error that can be tolerated in a worm wheel eight feet in diameter. Thus the maximum allowable error in driving, when measured at the 100-foot focus, does not exceed one one-thousandth of an inch. This error must represent the sum of all possible errors in the entire driving mechanism.



AN ELECTRIC DRIVE

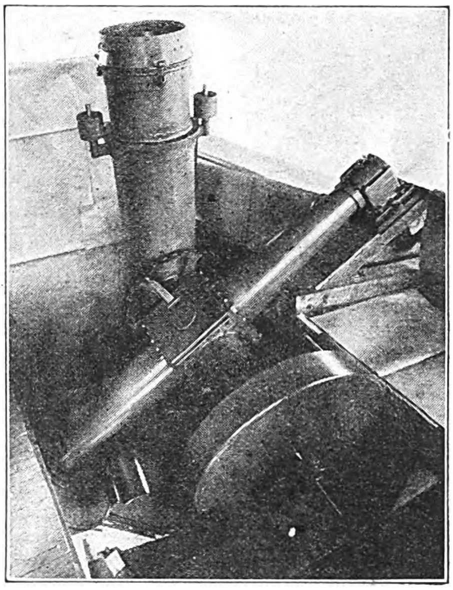
Lower end of 24-inch Harvard refractor, showing quick and slow motion gearing and electric drive, also dust-tight cover

Naturally, when the size of the telescope is materially increased, the standards of accuracy must be correspondingly increased, so that there will be no visible driving error. Such a driving worm wheel is usually cut by mounting on it an accurately divided silvered circle upon which the settings are read by means of two micrometer microscopes. The worm wheel with the circle is moved for each tooth, and is indexed through the two microscopes. "Cutting around" is done and measured several times, and after the final cutting the wheel is ready for lapping and correction of the spacing of the teeth. A final check by optical methods makes possible an accurate check of the worm and worm wheel before the instrument is tested on the stars.

Next for consideration comes the problem of providing for setting the telescope accurately on a star or other object. To move with precision a mass of 18 tons, so as exactly to bisect a star image with a cross wire of spider silk only about one ten-thousandth of an inch in diameter, calls for a nice balance of all forces. Thus the telescope must be perfectly balanced in all positions; the bearings must be very sensitive and properly proportioned so that there will be no sluggishness. The driving parts must be free from lost motion, spring, or deflection. Any departure would mean that the image could not be moved a desired fraction of a thousandth of an inch without moving it too much or too little.

THE story does not, however, end here. The accuracy must be maintained almost indefinitely. Exposed as a telescope is to heat, cold, dust, sweating, and freezing, it must be made so as to eliminate as far as possible the effects of these deteriorating agents; also to require the smallest possible outlay of effort and expense on upkeep and care. In other words, it must be "neglect-proof," as far as this may be accomplished. Compared with the size of his task, the astronomer's life is not a long one—and on winter nights not a merry one. Hence, any point of design that lends itself to releasing the observer from inconvenience in operating an instrument, or spending valuable time on its care and upkeep, can not help being a welcome aid in the progress of research. All gear drives, then, operate in oil baths within oil-proof and dust-proof cases, and the entire assembly of a drive unit is located under a dust-tight cover which can readily be removed if necessary.

The fact, also, that the observer's work is done the greater portion of the time in the dark, has led to the development of the simplest means of operating the controls—that is, electrically wherever possible. A light portable switch box with push buttons, on a six-volt circuit, operating relays and dynamic breaking controllers for the motors, is usually used. The box has either four or six push buttons, the four-button type giving slow motions, forward or reverse in right ascension and declination. The two extra buttons give quick motions. The motions are all electrically interlocked so that two speeds can not be engaged at once. The wiring is led by means of cables from the observing station, through the hollow axes and to the main switchboard, generally on the observatory wall. This switchboard is frequently quite complex for, in addition to the telescope motions and electrically operated clutches, many wires are brought to the observing point for such accessories as spectrographs, micrometers, guiding eyepieces with illuminated crosswires, and so on.



TWO-FOOT REFRACTOR

A 24-inch photographic refractor designed and constructed for Harvard University Observatory at Bloemfontein, S. Africa

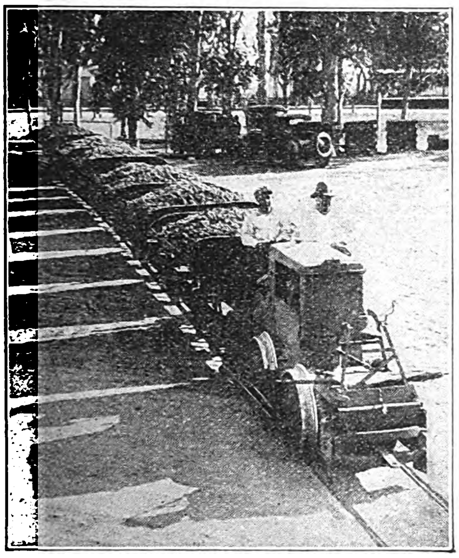
The many accessories, such as spectrographs of various types and sizes, interferometers, photometers, plateholders, and micrometers, to say nothing of the observing platforms and domes, each has its own peculiar set of problems, which must be intimately known to the designer and carefully studied before a successful design can be arrived at. Each new instrument is different from the preceding one, built for a special program of scientific work, yet each must work the first time—and will, if designed with the precision and care which has been explained.

The newest telescopes, although more complicated mechanisms than those of a generation ago, are simpler to operate and care for, and are also considered pleasing to look upon. They have the highest degree of accuracy yet attainable by available scientific and engineering methods.

With continued unselfish co-operation on the part of the astronomer we anticipate further achievement in this peculiar brand of engineering—designing and creating immense, massive instruments having the refinement and rigidity of the smaller ones.

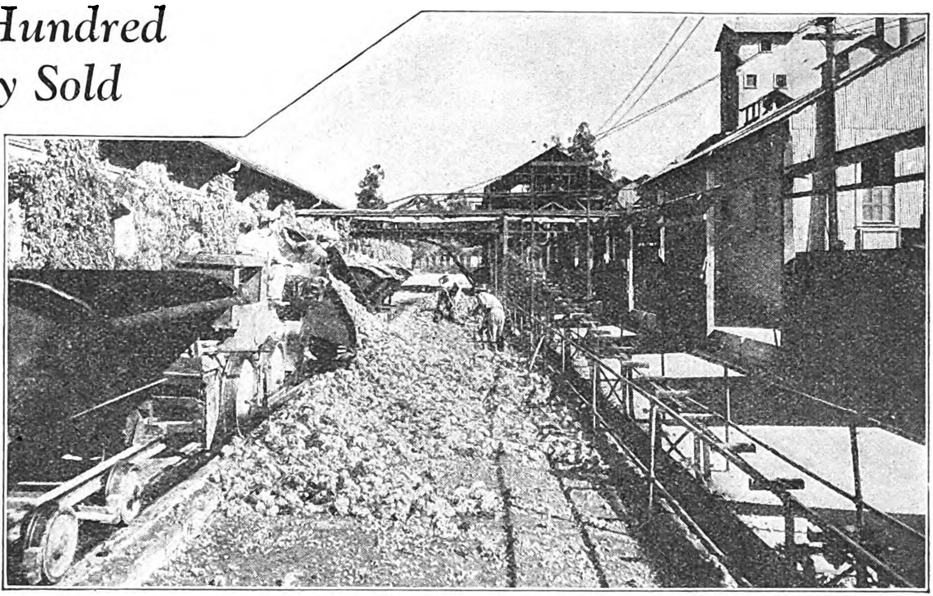
Machinery and Chemical Control

Two Thousand Five Hundred Which Can Be Legally Sold



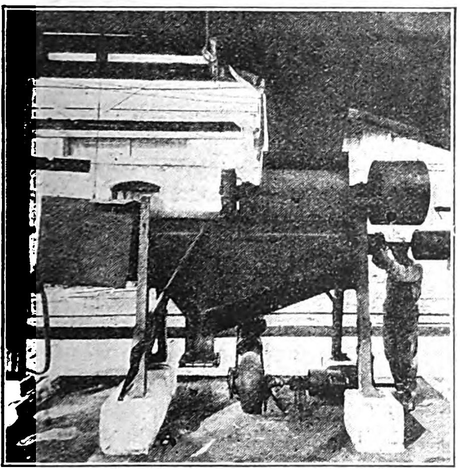
BRINGING IN THE FRUIT

Cars holding one and one half tons run over 22 miles of railroad carrying the fruit from the fields to the huge crushers



A BUSY TIME AT THE PLANT

The cars bring in the grapes from all over the 5000 acres of vineyards. They are dumped at the plant and shovelled on to a conveyor belt which carries the grapes to the crusher



NATURE WILL FERMENT! ➤

The fermenting house contains 200 five thousand gallon tanks. It is possible to ferment 1,000,000 gallons of juice at a time

⮜ THE MIGHTY CRUSHER

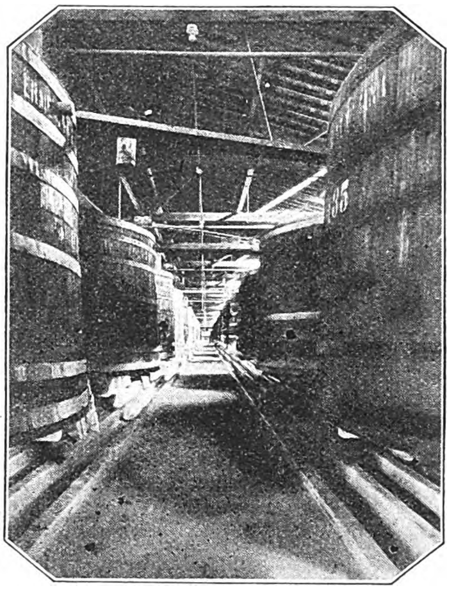
The crusher has a capacity of 40 tons an hour. It stems and crushes the fruit. The stems are afterwards used as fertilizer

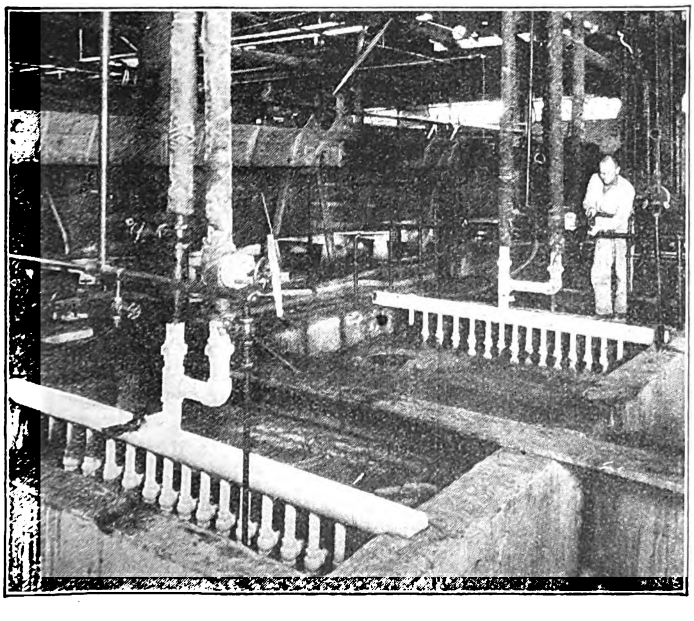
REFRIGERATING THE JUICE

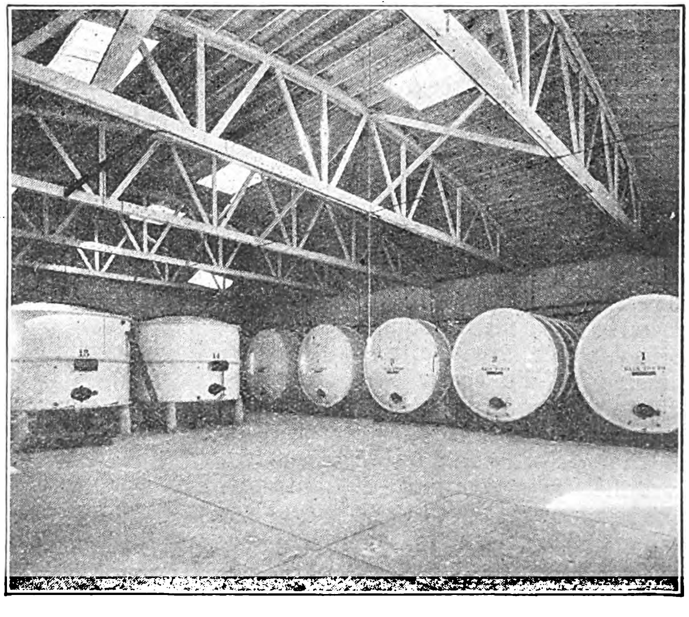
Below at left: The grape juice must be submitted to refrigeration as otherwise it will ferment. Grape juice is a popular drink

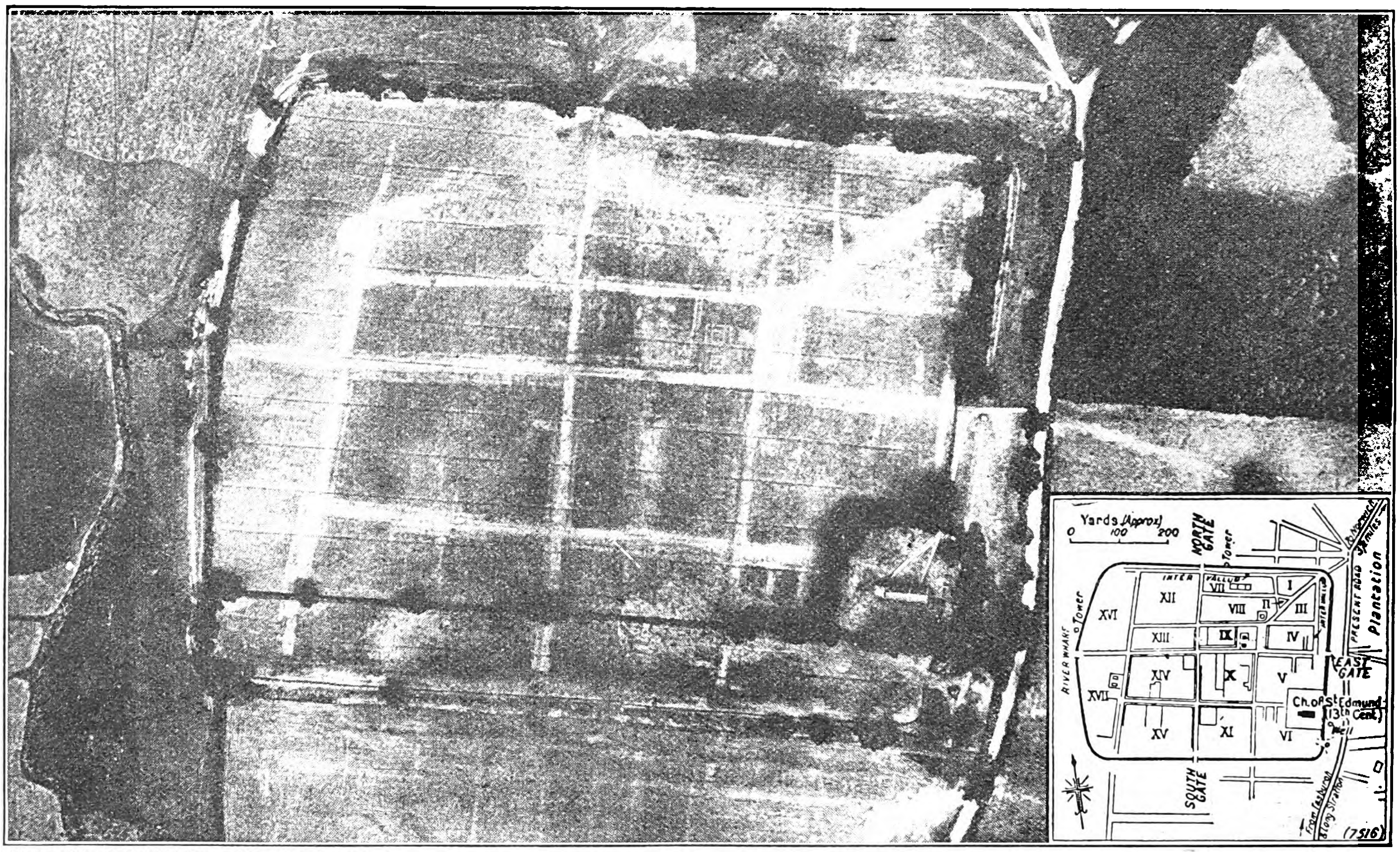
STORING GRAPE JUICE

Below at right: The great enamel-lined steel storage tanks are of 14,000 gallon capacity and are used for storing grape juice before shipping. The utmost cleanliness prevails









Photograph by the Royal Air Force. Crown Copyright reserved

A REMARKABLE PHOTOGRAPH OF A ROMAN TOWN IN BRITAIN, TAKEN FROM THE AIR

The outlines of the ancient streets and buildings show plainly, as diagrammed in the corner map. Yet none of them is actually visible on the surface, for the area is a field of ripening barley. The true explanation of this anomaly will be found in the text below

Ancient History from Aloft

A Fascinating Archeological Discovery by Aerial Photography, a Method Now Being Developed in Europe

By J. REID MOIR,
Suffolk Institute of Archeology and Natural History

ONE of the most important and extensive excavations of a Roman site in England is now being undertaken in East Anglia. About three miles to the southeast of Norwich, the capital city of Norfolk, lies the great Roman camp or town of Caistor. With the exception of Colchester in Essex, there was no place in the eastern part of England equaling in size and in importance that of Caistor. Although this is the case, no excavations have hitherto been carried out at this impressive site with its immense protecting ditch enclosing an area of no less than 35 acres. Inside the ditch are to be seen lengths of massive walls, made of flint and Roman bricks, which have withstood the slow passing of the centuries. They indicate the importance of Caistor in the far-distant past.

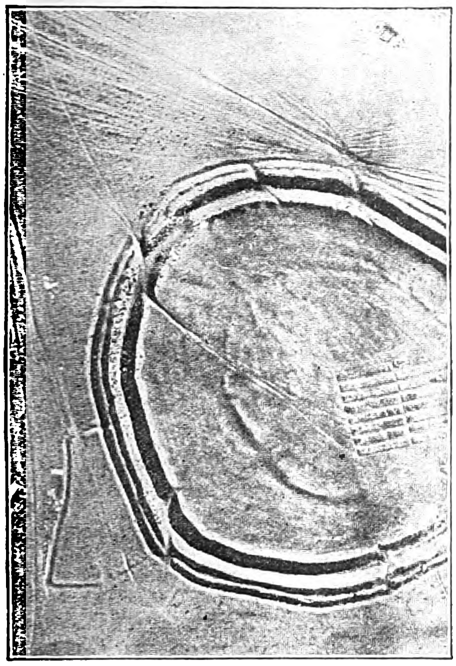
There is little doubt that this place was the Venta Venorum (the center of the Iceni) of the Ninth Iter of Antonius (about 320 A.D.). The Iceni were the inhabitants of East Anglia who, under their brave and warlike queen Boedicea or Boadicea, rose against the Roman rule and were only suppressed after extended and sanguinary fighting. It is possible that Caistor was the headquarters of Boadicea and this fact, together with the probability that the site was a flourishing town till towards the very end of the Roman occupation, make the excavations which have now begun of surpassing interest.

FOR many years past the plow and the activities of rabbits have brought to light at Caistor numerous coins, ornaments, utensils, and pottery. In 1846 a Roman villa was discovered and excavated in a neighboring garden. But, though these discoveries have been made, no attempt to investigate the great enclosure at Caistor had been undertaken until, under the auspices of the Norfolk and Norwich Archeological Society, aided by a number of experts, the present much needed work was initiated.

For some years it has been noticed during the summer that whenever the land within the enclosure at Caistor was covered with ripening grain curious intersecting white lines appeared where the crop had been starved of plant food owing to the roots meeting some hard subsoil or foundation. These lines, which were visible at a distance only, were thought to represent the areas where the streets of the town existed. But there were no signs above ground of the existence of buildings.

During the summer of 1928, as the barley was ripening, the lines became pronounced, and by a wise decision the Air Minister was asked to allow the Royal Air Force to practice upon this photographic target. The Royal Air Force has already rendered invaluable services to archeology by taking photographs of certain sites from the air, and thus revealing in a truly remarkable manner important details quite invisible to any investigator on the ground. The photograph of Caistor Camp taken by the Royal Air Force, must, I think, be regarded as a record in such matters. Not only does it give an accurate plan of the streets, in some places with abutting walls; but, what is more extraordinary, it discloses the existence of many most interesting buildings within the enciente. Further, this wonderful photograph affords some evidence that the surrounding *vallum* was constructed after the streets were made, as they appear in places to continue their alignment outside the confines of the camp. This implies the existence of a Roman town before the fortification of any part of it became necessary.

The air photograph also reveals the sites of buildings which can hardly fail to be of the utmost interest and importance. Insula IX, (see insert map, in photograph) which attracts most attention, is near the northeast center and contains what appear to be two temples. It is thought that Insula X will prove to be the forum and basilica, and it is to be remembered that the exact position of these temples, as well as of the other buildings, has been revealed solely by the slight bleaching of the barley above them. The long, parallel, thin, dark lines are, however, modern, being caused by the effect on the grain of large plow furrows.

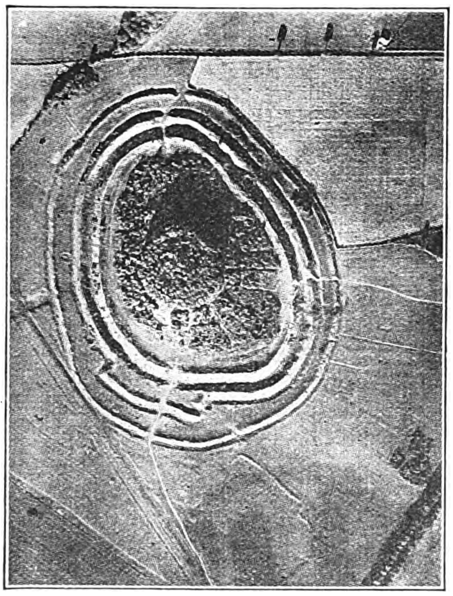


YARNBURY, COUNTY WESSEX

Earthworks around a plateau camp. Inner circle is older—perhaps earlier than Iron Age, but the grid is modern

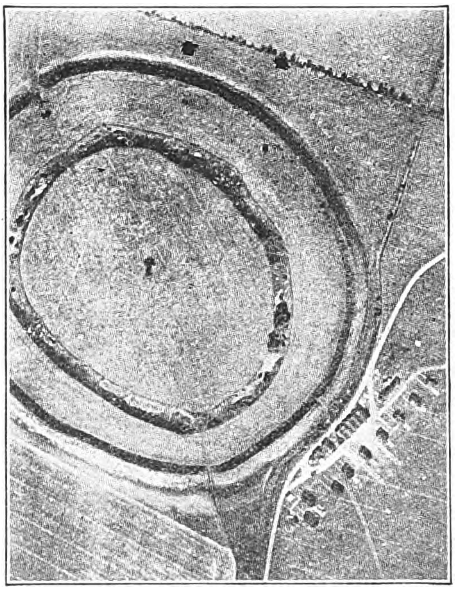
Among the many things upon which the Caistor excavations will throw light, it is hoped that something will be ascertained about the obscure subject of Christianity in Roman Britain. A church may be found, as at Silchester, while if the whole area could be excavated and none was discovered, that in itself would be very valuable evidence.

A matter of great interest which it is hoped to clear up is whether the temples remained in use for their original worship up to the end of the Roman occupation, or whether they were taken over by the Christians, or altogether desecrated. The only building above ground within the *vallum* is the ancient medieval church of St. Edmund. The photograph shows very clearly that this church was erected in complete disregard of the original planning of the town, which by then had no doubt fallen into decay and disuse. After the departure of the Romans in Anglian times, Caistor was abandoned and superseded by Norwich, so there is every reason to expect that the site will be found undisturbed by any later occupation.



MORE AIR ARCHEOLOGY

Badbury, a pre-Roman hill-top camp, showing ramparts and defenses. The illustrations on this page, reproduced by permission from Crawford and Keiller's "Wessex from the Air," by courtesy of The Clarendon Press, Oxford, have no connection with the illustration on the opposite page, except as examples of air archeology. These camps, unlike the other, are prehistoric but are easily visible from the surface, standing in relief

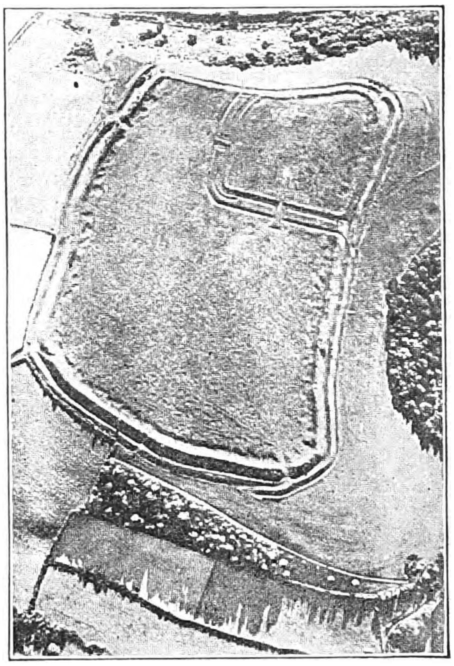


FINSBURY RINGS

This camp, perhaps an arena for chariot racing, has been scientifically excavated since the above photograph was taken

It is seldom that such an opportunity for a successful excavation occurs, and the Norfolk and Norwich Archeological Society evidently recognize this fact. They have been so fortunate as to secure the services of Mr. Donald Atkinson, an acknowledged expert on such work, to supervise the diggings, and no better choice could have been made.

It is by no means easy to exaggerate the importance of the excavation of an untouched Roman town which existed throughout the whole period of imperial rule and felt the first brunt of the barbarian invasion. The Caistor site has probably never been seriously interfered with since it was abandoned by the Roman provincials about the middle of the 5th Century, and great results are confidently expected from the work now set on foot.

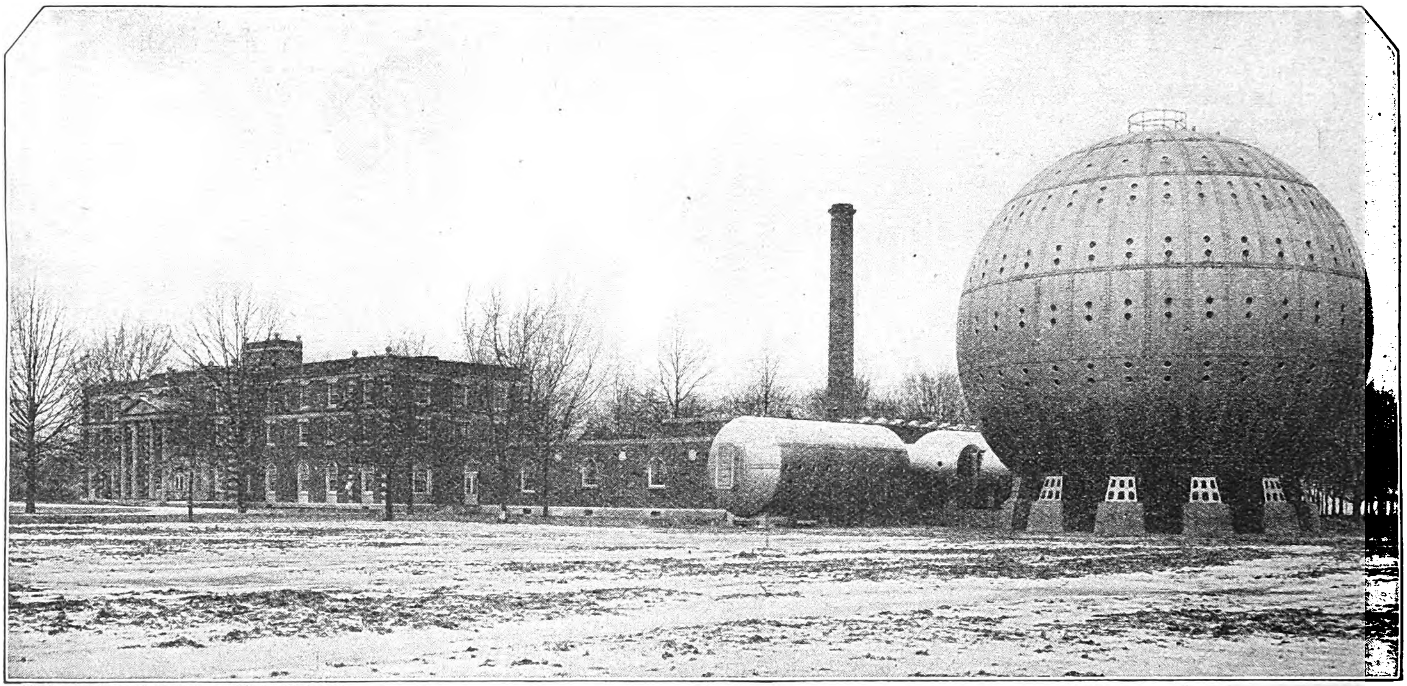


HOD HILL, A HILL FORT

This shows a Roman encampment within a prehistoric encampment, surrounded by modern fields. The preservation is good

The scientific examination of such sites are of world wide interest, and archeologists and others from many countries will no doubt visit Caistor to see for themselves what Mr. Atkinson and his colleagues are discovering. Such work, however, cannot be carried out without incurring considerable expense and a subscription list has been opened at Barclay's Bank, Ltd., Bank Plain, Norwich.

There is romance, as well as history, connected with a site like the great camp at Caistor, and as the diggings proceed I shall hope to give in some future number another account of the discoveries which are made, to the many readers of the SCIENTIFIC AMERICAN.



All photographs courtesy of General Electric Company

CLEVELAND'S MILLION-DOLLAR STEEL BALL SANITARIUM

Every facility found in the usual hospital or sanitarium is provided in this unusual structure, in which victims of diabetes, anemia, and other diseases receive treatment in an atmosphere of compressed air for about five days, in addition to medical attention

Compressed Air Used In Novel Hospital

WITHIN one of the queerest hospitals ever constructed, located in the city of Cleveland, victims of diabetes, pernicious anemia, and other diseases are treated by means of compressed air. The customary aids of the medical profession are used also, including serums, medicinal preparations, and regulated diet. Rising to a height of five stories, the structure appears to be a huge silver ball with portholes in the side. The million-dollar steel ball has a diameter of 64 feet; the exterior is covered with an aluminum paint, and presents one a novel sight.

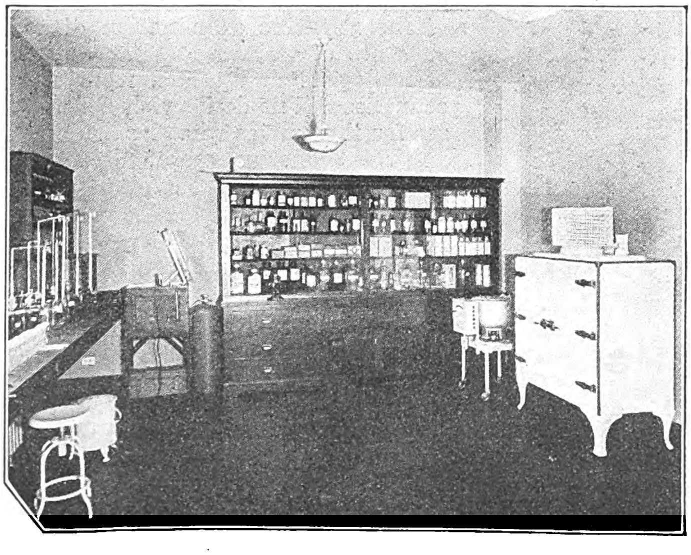
Cunningham Sanitarium, as the structure is known, was built by H. H. Timken, a wealthy steel manufacturer of Canton, Ohio, to enable Dr. O. J. Cunningham to demonstrate his theories as to an improved treatment for diabetes and other diseases. The interior of the tank is equipped with every convenience to make the patients feel at home. A dining hall occupies the first floor. The three floors in the interior of the ball are divided into hospital rooms, and on the top floor there is a recreation room.

Although the treatment is administered for a variable period from 30 to 60 days, only five days are spent in an atmosphere of compressed air. The hospital is entered through a small cylindrical tank which adjoins the Administration building. When the compressed air is released in the small tank, the patient feels as if he were falling from a skyscraper, but the effect is not harmful and the uncomfortable sensation soon disappears, it is said.

Unusual requirements necessitate the best refrigeration available, to preserve serums and medicinal supplies as well as the food for the patients. A special General Electric refrigerator mounted on a rubber-tired carriage is wheeled through the compression room into the dining room, from the kitchen in the Administration building.

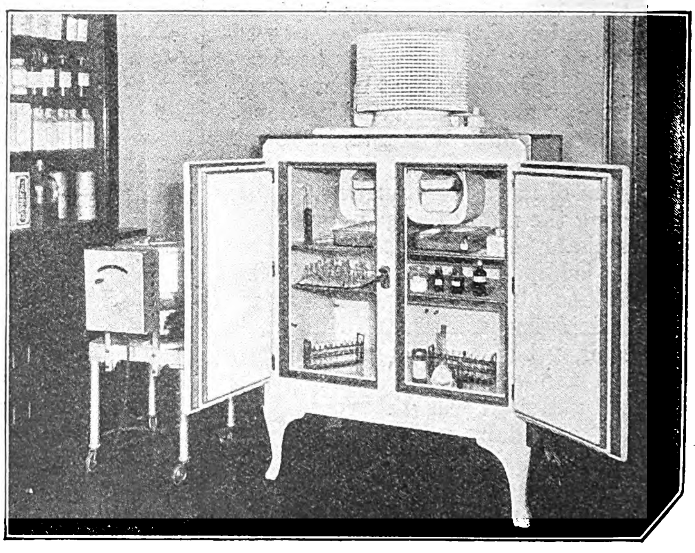
LABORATORY AT THE CUNNINGHAM SANITARIUM

In this spotless laboratory are kept serums, sodium hyper-bromite, and other medical aids, which supplement the air treatment



MODERN REFRIGERATION IN A NEW ROLE

Here refrigeration is used to preserve serums and medicines, as well as food. A refrigerator mounted on wheels is used when serving



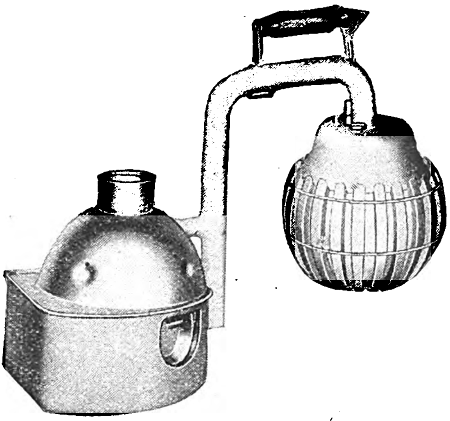
The "Heat Makes Cold" Refrigeration Unit

SIMPLIFICATION of design is one of the great forces in our era that is daily putting luxuries within the reach of all. The history of mechanical refrigeration affords a marked example of this process. First there was the electrical refrigerator; then came the highly efficient gas refrigerator; and now we have perhaps the simplest, most compact of all: the Icyball. This unit, which is as simple as a tea kettle, utilizes the heat of any stove—gas, oil, coal, et cetera—to keep a refrigerator cold. The fuel cost of operating it with gas is about two cents for each heating which gives refrigeration and freezes ice cubes and desserts for from 24 to 48 hours. The unit weighs about 35 pounds and consists simply of two balls that are connected with a length of pipe and equipped with a carrying handle.

In the illustration at the right, the ball with the fins is called the "hot" ball and the other is the "cold" ball. These, with their connecting tube, are sealed so that the liquid within does not evaporate even after years of use. The liquid is a solution of ammonia and water—practically the same as household ammonia—weighing 14 pounds.

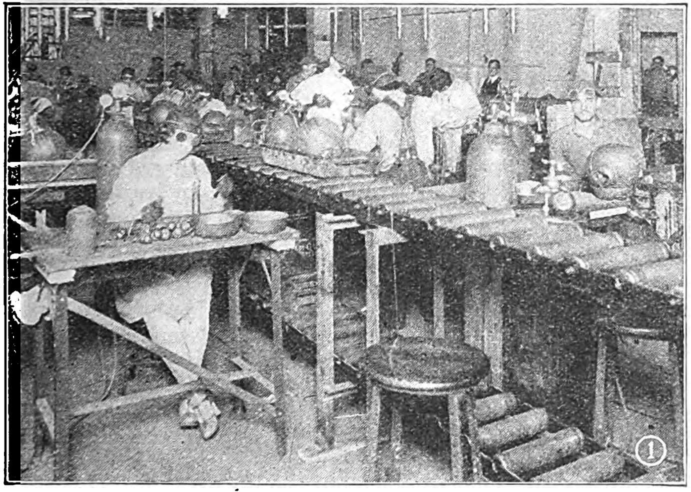
To charge the Icyball, it is lifted from the cabinet and stood on end so that the liquid all drains into the hot ball. Then when the hot ball is heated, the ammonia is evaporated out of the water and is driven, as a gas, into the cold ball where it condenses. During this heating, the cold ball is immersed in a pail of cold water to expedite condensing of the ammonia. When the process is complete, the cold ball is inserted in the cabinet, the ammonia begins to evaporate rapidly because of its affinity for water, and the evaporation causes its temperature to drop to a very low point in the neighborhood of zero.

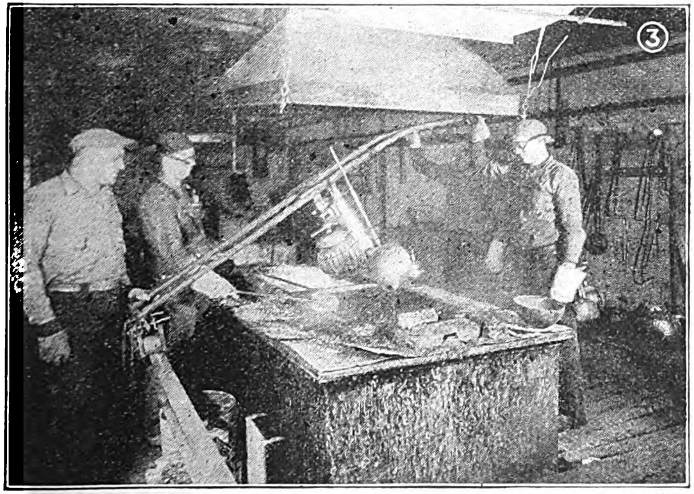
The numbered illustrations on this page show steps in the making of this unit: 1—View of the assembly line where balls are welded; 2—Completing the assembly; 3—Dipping the unit into gas-fired tank of molten zinc during galvanizing process; and 4—A section of the testing department where units are fully tested.



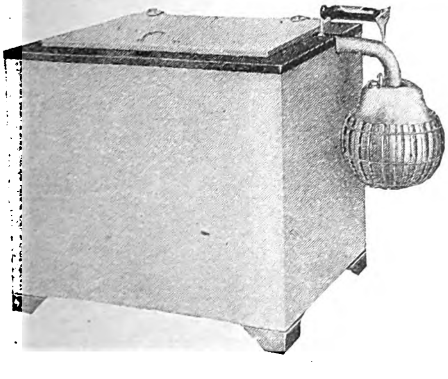
EASY TO HANDLE

The complete unit which cools after being "charged" by heating, weighs 35 pounds





Illustrations courtesy the American Gas Association



IN ITS CABINET

The cold ball hangs inside the refrigerating compartment, the hot ball outside

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Our Newest Fighting Tank

SINCE Major Campbell's article on page 216 was written, a new tank invented by J. Walter Christie, automotive engineer, has been tested at Fort George E. Meade, Maryland, before a group of military experts. The performance of this new war machine, which carries a crew of three men, was so amazing that it elicited expressions of astonishment and praise in many quarters.

Over rough terrain — soft plowed ground—the new tank made a speed of over 42 miles an hour and, with its tread removed, it made a speed of over 62 miles an hour on a concrete highway.

Technical details of this land "battle cruiser" are being closely guarded but reports state that its motive power is a single Liberty motor. Its tread, which is used when it is traveling across country on typical battlefield ground, is removed when it is desired to drive the tank on improved roads, the transformation being effected in 14 minutes. Endurance tests have not as yet been made and it is impossible to estimate just how long this racing tank will "stand up" without an overhaul. It is believed, however, to be sturdily designed and capable of long service.

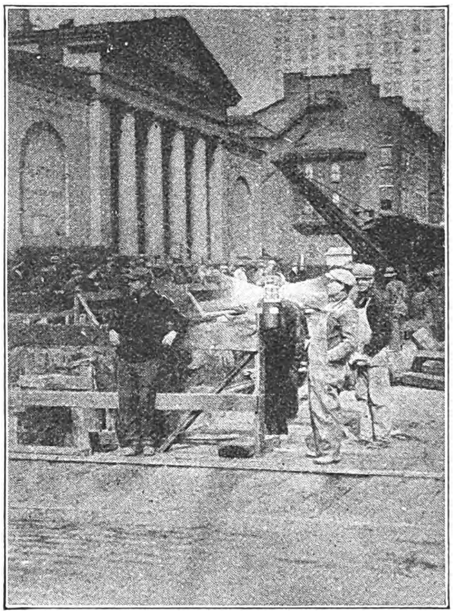
Portable Flashing Warning Lamp

THE development of an automatic warning signal, with far greater visibility than the ordinary oil lantern and more cheaply operated, has aroused widespread interest among contractors, road builders, and all concerns engaged in outside construction work.

Announcement of the development of the new signal after more than a year's research, was made recently by the National Carbon Company, Cleveland, Ohio. The new signal is known as the Everready Portable Flasher.

Research experts of the company have found that the average kerosene oil lantern costs 50 dollars per year or more, for filling, cleaning, replacement of chimneys, and depreciation. While the first cost of the flasher is considerably more than the initial cost of the oil lantern, its maintenance is said to be so much less over a reasonable period of time that it saves its cost and then makes steady reductions in upkeep. Additional savings are realized, it is said, from the fact that the greater warning power of the intermittent flash enables one flasher to displace several oil lanterns and at the same time give much greater protection.

Another distinct advantage of the flasher is the fact that it is readily portable, the entire unit, fully equipped with batteries, weighing only 16 pounds. The batteries used are standard. The intermittent flash uses the battery capacity to best advantage, making them last much longer than they would under a steady load.



The recently announced automatic warning signal lamp, the flashes from which have high visibility

The specifications of the new signal warning are: Height, 16 inches; diameter of base, seven inches; and weight, including the large dry cell batteries, 16½ pounds.

Once it goes into operation, the flasher requires no attention whatever except to replace batteries every two to three months. It requires four standard dry cells connected in series to deliver six volts. An extra six-volt lamp is inside the battery housing. The battery compartment is constructed of seamless steel finished in red and the top is cadmium plated for weather protection. The heavy red glass lens throws a powerful warning beam. The padlock for the battery compartment has an extra long hasp so that the flasher can be chained and protected from theft. The rugged construction throughout makes the whole signal completely weatherproof.

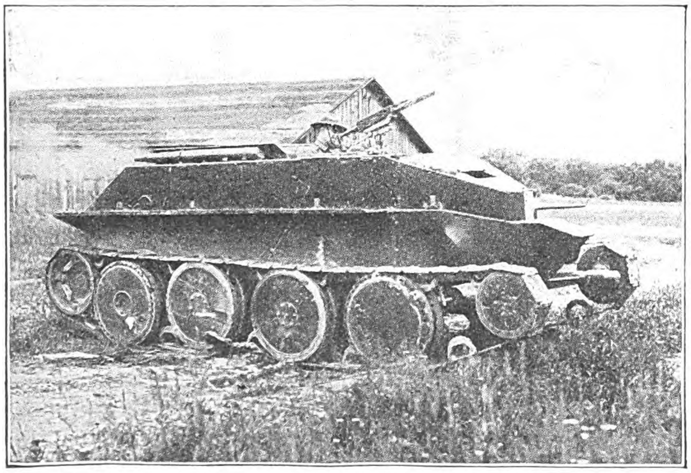
Self-Lighting Cigarettes

IN the chemical laboratories at Ames, Iowa, Miss Annella Wieben and Dr. F. E. Brown, of the faculty of Iowa State College, have invented an igniting tip for cigarettes. This tip is on the order of a match head, although it is chemically different. It insures the lighting of the cigarette without the use of a match or other external heat producer.

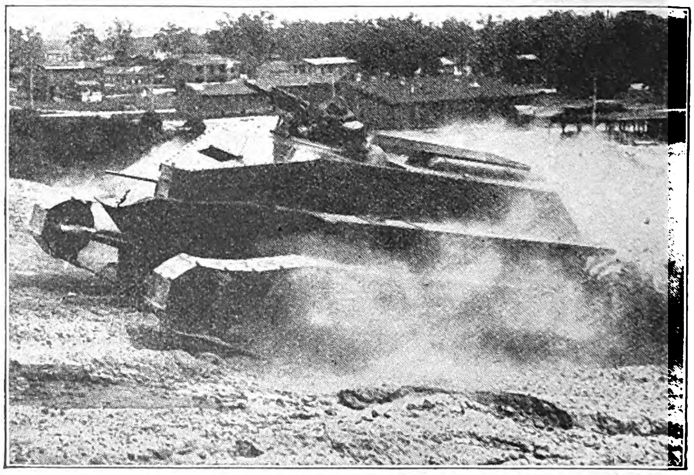
The idea of a self-lighting cigarette did not originate with Miss Wieben and Dr. Brown. As long ago as 1881, a Russian inventor is known to have taken out a German patent on some such device. The chief fault with his invention, as well as with others that followed it, was the fact that a disagreeable taste and smell accompanied the lighting of his tip, which was a compound of sulfur, phosphorus, et cetera, like the old-fashioned match head.

Several inventors have since attempted to improve upon this idea and have even secured patents for their improvements, none of which has turned out to be successful.

Now come these two Ames chemists who assert that their invention meets all of the objections made to its predecessors; and, because it is simpler, more feasible, and inexpensive, they feel that it gives every promise of being a complete success.



The high-speed tank which was recently tested at Fort George E. Meade. It is the fastest in the world

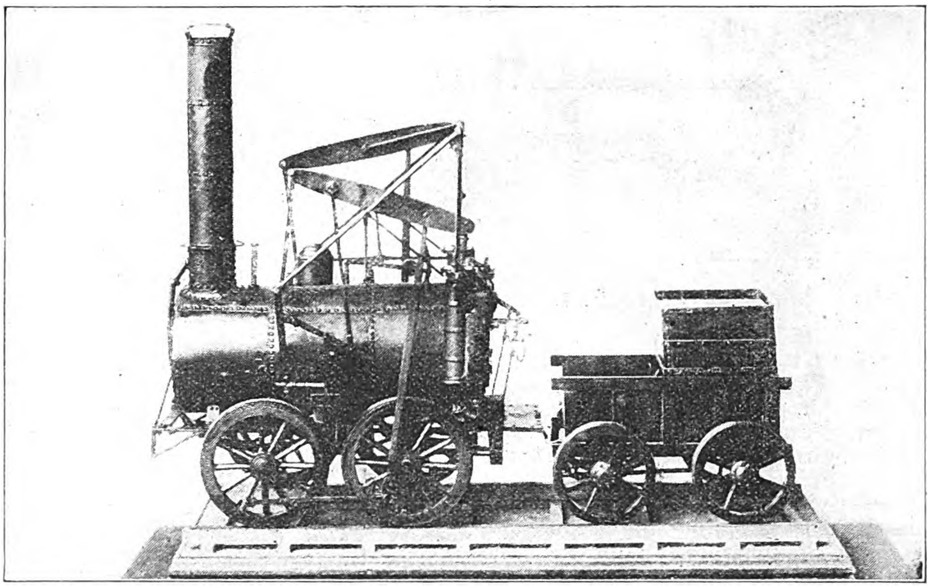


The new tank races over rough ground with the speed of an automobile or, with tread removed, on highways

The composition which they use in tipping their cigarettes is such that it ignites readily when rubbed on a specially prepared surface much like that used for the lighting of safety matches. This scratching surface may be attached directly to the package of cigarettes. There is no more danger of burning pockets or coat-tails with this substance than with a box of safety matches.

Perhaps of even more interest to the smoker is the fact that this latest tip will ignite even in a high wind and, above all, in every case it will stay lit. Furthermore, the new tip lights with very little flare, without giving off any odoriferous or harmful gas, and without affecting the cigarette's flavor—chief objections to other inventions of this sort.

A number of several well-known brands of cigarettes having the new "match" tips were tried by the editors and so far as they are able to judge, the statements in the preceding paragraphs are true.



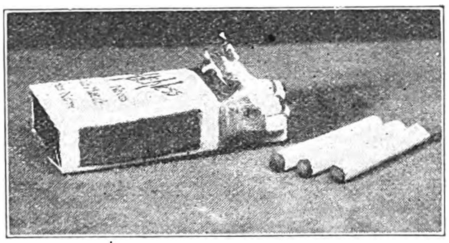
Model of the first locomotive to run on tracks in America

America's First Locomotive

IN our August 1929 issue we made brief reference to the locomotive *Stourbridge Lion* in connection with an item concerning the growth of the railroads. Since this locomotive was the first to run on rails in this country and August 8th was the centennial of this epoch-making run, a few remarks concerning it should prove of interest.

On July 16, 1828, Horatio Allen, a resident engineer during the construction of the Delaware and Hudson Canal, was sent to England for railroad iron and to have four locomotives built under his supervision. At that time not a single railroad steam locomotive had ever turned a wheel on any track in the United States. Mr. Allen ordered four and the *Stourbridge Lion*, built by Foster, Rastrick and Company, Stourbridge, England, was the second to be delivered, reaching New York on May 13, 1829. Its cost delivered was $2914.90. This locomotive, together with the *America* which had arrived in New York at an earlier date, was sent up the river on July 2nd. It reached Roundout on July 3rd and was sent from there up the canal to Honesdale, Pennsylvania.

At Honesdale, Horatio Allen was waiting to receive the *Stourbridge Lion* and under his direction it was placed upon a track which had been built three miles into the woods to the site of Seelyville. Mr. Allen unaided and alone drove this locomotive the full length of this track, partly over a curved trestle, and returned to the starting point by reversing the engine.



"Matchless" cigarettes that light when their tips are scratched on the side of their own container

As a fitting memorial to this national event the citizens of Honesdale, Pennsylvania, observed on August 8, 9, and 10, 1929, a celebration which included the dedication of a monument, a transportation parade, and other ceremonies.

It is not always possible to skid logs by gravitation to water or to railroads; sometimes the job is uphill work. Here, three "Caterpillar" sixtys, in tandem, are towing a redwood log containing 8200 board-feet to the railroad for shipment. The log is 20 feet long and weighs more than the three tractors

Static Electricity Imperils Cotton

IT does not seem likely that 12,000,000 matches got mixed up with the cotton crop in one year. Yet that is the number that would have been necessary to cause all the fires recorded at ginneries—if matches had been the cause. Government scientists mixed 600 matches with seed cotton and ran it through a gin, causing only four small fires in the huller breasts. Looking for another cause, they found the old culprit, static electricity. This is generated wherever there are moving parts and must be carried off to the ground by a good electrical conductor to remove its danger. Where belts are used it is particularly likely to occur in damaging quantities.

Evidence was found that it was the major cause of fires in cotton gins. Distributors of gasolines and oils have long been aware of its danger. That is why oil trucks invariably have a loose chain suspended from the chassis and dangling along the ground. It carries off the static electricity generated by the sloshing of the oil in the tanks.—*New York Herald-Tribune.*

Radio Does not Make Rain

DR. JOHNSON has immortalized a brief chapter "concerning snakes" whose full text is: "There are no snakes to be met with throughout the whole island." Thus it is with the alleged effects of wireless on weather. The Symons memorial lecture of the Royal Meteorological Society for 1929 points out that the average rainfall of England requires for its production the expenditure of energy at the rate of a third of a million horsepower per square mile night and day throughout the year. This is the rating of the largest electricity generating station in Great Britain. The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods

(Please turn to page 263)

Learning to Use Our Wings

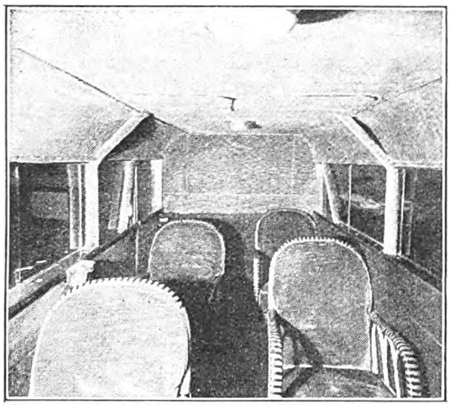
Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

The "Flamingo," a Metal Plane

AMERICAN airplane constructors are rapidly turning to the all-metal type and the *Flamingo*, built by the Metal Aircraft Corporation of Cincinnati, is an interesting example.

In outward appearance the *Flamingo* is neat, but conventional. It can be equipped with either the Pratt and Whitney 410-horsepower Wasp, or the Pratt and Whitney 525-horsepower Hornet. The seating capacity is 8. There is a mail and baggage compartment of 40 cubic feet. The span of the wing is 50 feet, and the over-all length is 32 feet 6 inches. The weight empty is 2960 pounds, and the weight fully loaded is 5600 pounds. The pay load is about 1400 pounds. The high speed with the Wasp is 135 miles per hour; with the Hornet 140 miles per hour.



Photographs courtesy Metal Aircraft Corporation

The luxurious interior of the all-metal *Flamingo* described herewith

In the early flying days, an airplane was an airplane, and very few instruments or accessories found their way into its construction. It is interesting to list what a well equipped machine of to-day carries as its ordinary equipment. Hand inertia starter, booster magneto, ignition switch, altimeter, tachometer, oil pressure and temperature gages, fuel pressure gage, 8-day clock, magnetic compass, air-speed indicator, navigation lights, canvas engine cover, engines and airplane log books, and first aid kit. This constitutes an imposing list which leaves little else to be desired.

Apparently the constructors of the modern airplane are not afraid of an all-metal covering for wings and fuselage; on the *Flamingo* this covering is .014 inch thick, and is therefore far heavier than fabric covering. The permanency of such a covering evidently makes it worth while to make some sacrifice in the matter of weight. Also, the metal covering does add to the strength somewhat. For local stiffness the metal covering is corrugated on three-inch centers with a semi-circular corrugation.

The spars of the wing are of "I" section, the flanges being built of extruded dural angles, with a dural web set between them. There are 36 ribs in the wing, made of flat dural sheet and all exactly alike, with holes punched and flanged to give lightness and rigidity. The construction of these ribs is but one example of the production methods which it is possible to apply when metal is boldly used.

The fuselage is of welded seamless steel tube throughout. The metal skin is fastened to light dural channels riveted to clips placed on the tubes.

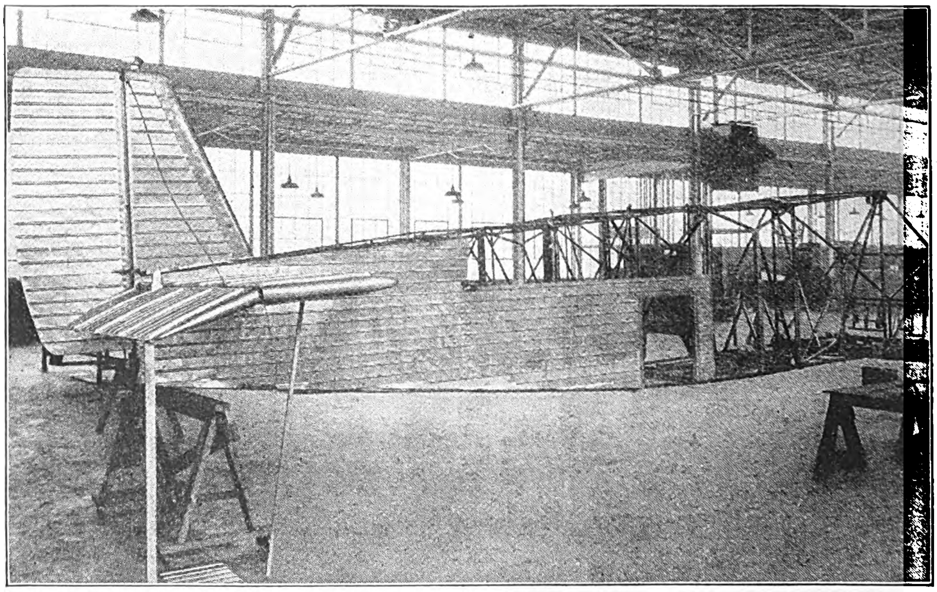
The main cabin is 50 inches wide, 60 inches high and 14 feet long. It is fitted with upholstered reed chairs secured to the floor.

Gliding in Germany

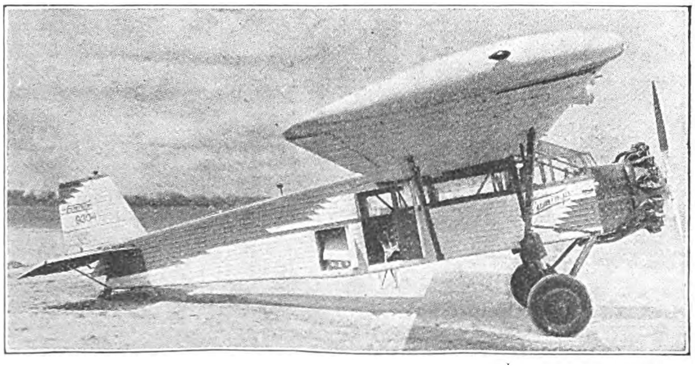
IN the *National Geographic* for June, 1929, Howard Siepen has a beautifully illustrated article entitled "On the Wings of the Wind." This is a most fascinating description of gliding as now practised in Germany and it contains many lessons for glider enthusiasts in this country.

There are in Germany to-day some 200 glider clubs, and in 1928 about 10,000 glides and flights were made. At last year's competition, in the Rhon Valley, 105 machines participated.

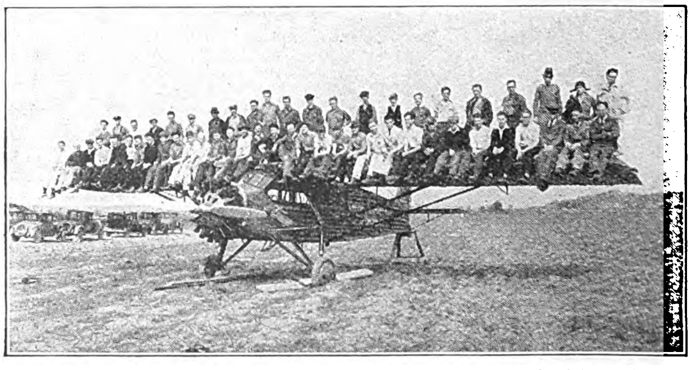
What is particularly interesting about the glider movement in Germany is that it introduces the schoolboy to the air. No boy should learn to fly a powered machine until he is at least eighteen years of age. But gliding instruction in Germany is open to



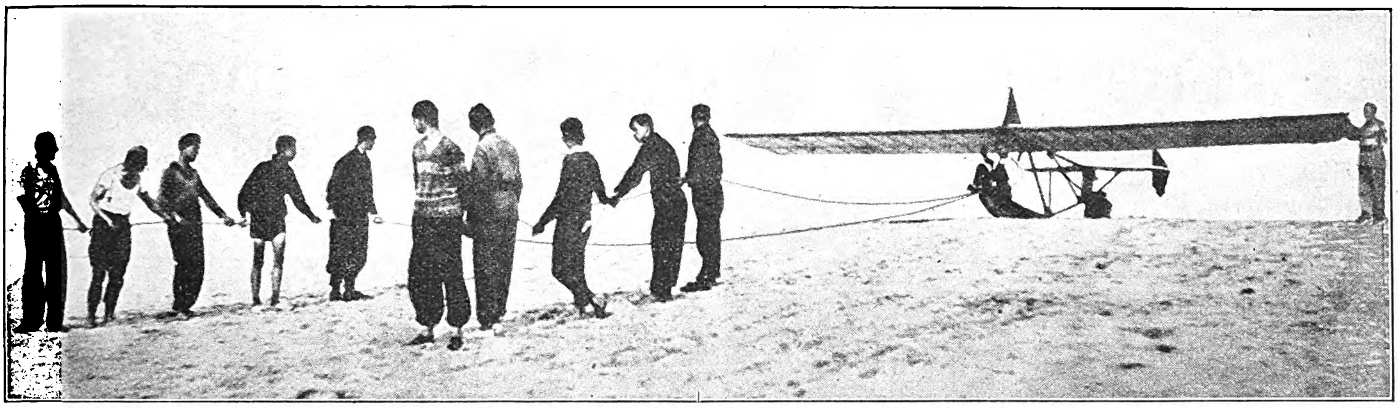
Fuselage of metal plane, partly covered with dural skin. Note tail assembly



Side view of the all-metal *Flamingo* equipped with a Pratt and Whitney Hornet engine of 525 horsepower



Showing the great strength of the wings of this all-metal plane. On the wings are 55 men, 10,090 pounds



Photograph by Howard Siepen, courtesy of the *National Geographic* magazine. © 1929

By means of long elastic ropes, gliders are snapped into the air

any schoolboy of fourteen years or over. Hundreds of schoolboys are now flying, and three thousand took flying instruction in 1928. Instruction is free and it is given by the school teachers themselves. This is said to be reassuring to parents, and no doubt it is. Also, in schoolboy instruction, only primary gliders are used, and these primary machines seldom glide more than 10 or 12 feet from the ground so that hazard is reduced to a minimum. Moreover, at the technical schools and universities, students form clubs for the construction and operation of gliders and have produced some really remarkable craft.

The glider movement in Germany is supported by airplane manufacturers and plane associations of various kinds. The thought back of the movement is that by gliding, the younger generation will become air-minded, and that the best pilots of the future will be produced in this manner.

The article brings out a distinction which is not always made in the United States between the glider and the "sail plane." A glider is a machine which, elevated a few feet in the air or launched from the side of a hill, will glide steadily downwards. A "sail plane" is a finer, more lightly built craft which, taking advantage of upward currents of air, will actually sail or fly in the hands of a skilled pilot.

Another valuable feature of glider work is that the student takes his first glide after merely verbal instruction. On his very first attempt he takes full charge. A man who begins training in this way is likely to become a more natural flier than the man who receives instruction in a dual, powered plane. Powered flying will come very easily after such practise.

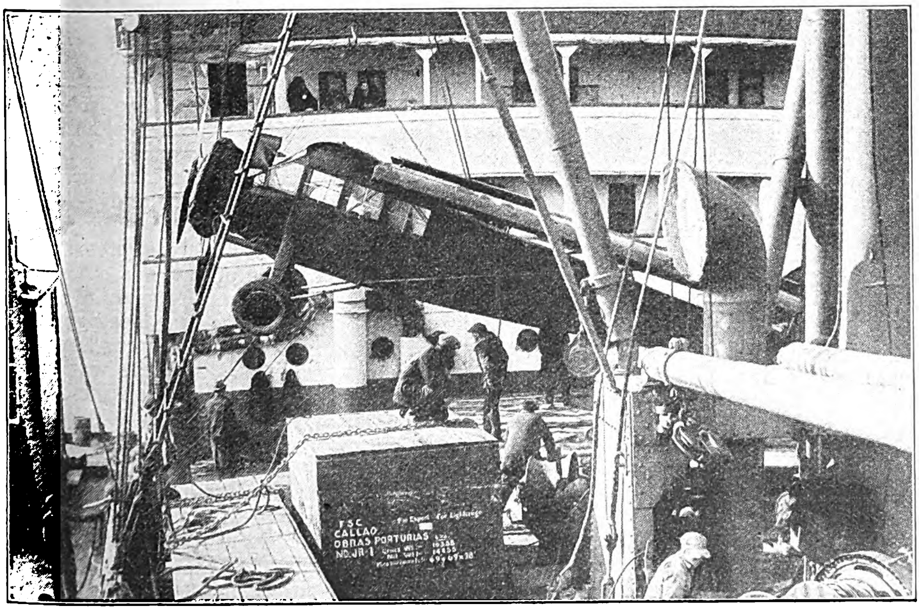
The sail planes have now reached a wonderful stage of development. Some of them have a wing spread of 59 feet and a chord of only five feet. This large "aspect ratio," together with the beautiful shape of the fuselage gives them a gliding ratio of 20 to 1, which is far better than the efficiency of any airplane. The airplane will ultimately approach the glider in efficiency, but it has a long way to go as yet.

It must be almost as much fun to launch a glider as to fly one. The pupil takes his seat and pulls back his stick so that the glider is ready to take the air. The instructor holds the ship on an even keel. At an order, two starting groups walk ahead, gradually drawing out the rubber launching. Then they run. Then the order to let go is given, and two men holding the tail of the glider release it. The elastic ropes launch the glider into the air as from a catapult. It is essential that the release mechanism for freeing the launching ropes from the glider function perfectly, as otherwise the maneuver is ruined.

Exporting Aircraft

AMERICAN exports of aircraft and aircraft engines are steadily growing. In 1925 the total value of aircraft exports was 783,658 dollars; in 1926 it had grown to 1,027,210 dollars; and in 1927 the value had risen to 1,903,560 dollars. The figures for 1928 are still larger. The principal markets for 1927 were Canada, Peru, Chile, and Soviet Russia. South America is a particularly attractive territory for the American manufacturer, and now that the Curtiss interests have formed a company to operate in China we may expect large exports across the Pacific.

In the early days after the war, Europe practically barred American products from the rest of the world, mainly because labor costs in Europe were so much lower. But as the industry attains a production basis, the superiority of American production methods begins to assert itself. Our photograph shows a Fairchild monoplane swinging aboard the Grace steamer, *Santa Theresa*. The plane is to be landed at Callao, the Peruvian Naval Base, where it will be equipped with pontoons. From there it will be flown to Lima for service over the Peruvian Airways, a line carrying passengers, mail, and express to the interior. The folding wings of the Fairchild monoplane make this plane particularly convenient for shipment by steamer.



A monoplane made in the United States, bound for Peru

Financing Aircraft Sales

IT is estimated that at the present time at least 50 percent of all motor cars are sold on the installment plan, and there is no doubt that adequate financing has greatly furthered the sale of automobiles, and there is reason to believe that many airplanes will be sold in similar fashion. At any rate, a number of airplane finance companies are already functioning and several types of planes have already been sold on some time plan or another. The Aviation Credit Corporation has issued an interesting pamphlet regarding its plans for financing of this kind.

The airplane distributor can now purchase planes by paying down only 10 percent of their price and receiving credit for the balance over a period ranging between three and six months. The rates of interest are to be the same as is the case with the automobile. An insurance policy covering fire, theft, and windstorm is placed through the finance company.

From the private owner the finance company will require a cash payment of 33⅓ percent, and the insurance policy required will be of a broader character, covering accidental damage, public liability, and passenger hazard in addition to the risks previously listed.

The financing of aircraft sales certainly deserves every encouragement.

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association *and of* Hygeia

The Weather and Pain in the Joints

FOR many years sufferers from "rheumatism" have said that their pain is worse in bad weather; and every village has its old inhabitant who can invariably predict a change in the weather by the pain in his joints. The impression is so definite on this subject that investigators in the Mayo Clinic determined to make a scientific study of the subject. Even Hippocrates noted that people living where cold winds prevail are more prone to acquire certain types of diseases than those who live in a climate not subject to cold winds. In the last 150 years many investigators have attempted to correlate barometric changes and rainfall with the occurrence of inflammations of one type or another.

In the investigations carried out by the Mayo Clinic, records were kept of the barometric pressure and the severity of the pain of the patient as estimated according to a definite scale over a long period of time. In addition, note was made as to whether the weather was clear and sunny, fair, cloudy, or included rain and snow. It was found that the presence of a storm was always associated with increased pain and that patients complained less on clear sunshiny days. The general improvement following a continued period of fair weather was always striking.

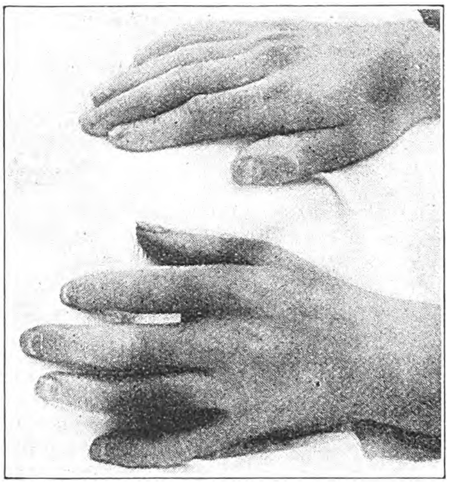
It was also found that there was a definite relationship between pain in the joints and the approach or presence of storm. One morning when the sun was shining brightly and there was not a cloud in the sky, 12 patients with inflamed joints seemed to be getting along excellently. Early in the afternoon one patient after another began to call for relief from pain, although the sky was still clear and sunny. Later in the afternoon an electrical storm suddenly appeared. Daily observations were made of temperature, humidity, and atmospheric electricity.

As a result of their studies of 367 patients over a period of a year, the authors conclude that there is a positive relationship for 72 percent of the time between the curve of pain and that of barometric pressure. For 21 percent of the time the relationship was equally as definite, but as one line went up the other line went down and only 7 percent of the time was the relationship undemonstrable. For more than 90 percent of the time there was a definite relationship between the presence of storm and increase of pain. The observations on humidity, temperature, and atmospheric electricity were inconclusive, but it is possible that all of these factors working together may have had some effect.

Arsenical Poisoning

IT has been known for many years that people who work in industries in which arsenic is involved have hair which is particularly glossy and a skin which is peculiarly pale. However, the definite relationship between the arsenic taken in and the effects on the skin and hair have been previously fully worked out. In 1927, six members of a family and the hired man on a farm in Sonoma County, California, developed severe arsenical poisoning. An investigation by the State Board of Health revealed the fact that arsenic, lead, and phosphorus poison, used for the extermination of rats, had been kept in a cupboard and that the father of the family who prepared the breakfast had by mistake put arsenic in the hot cakes instead of baking powder.

Drs. Theodore L. Althausen and Lewis Gunther decided to investigate these cases with special reference to the excretion of arsenic through the hair. Arsenic is found in the hair after taking a single or repeated doses of the substance, but it does not appear there for many hours after it can be found in abundance in the internal organs. At the earliest, it has been demonstrated in the hair five days after the poisoning occurs. However, the hair content of arsenic per unit of weight exceeds that of all of the other tissues and the excretions of the body in chronic cases of poisoning with this material. Furthermore, the hair contains the arsenic much longer than any other structure of the body, including the liver and the bones, a fact which is accounted for by the continuous depositing of arsenic in the hair from all over the body. It is, of course, important to remember that the arsenic in the hair is not re-absorbed for excretion through other channels. The authors also noted, following arsenical poisoning, the appearance of white transverse bands on the finger and toe nails, which they account for by the deposit of arsenic in the nails.



View of the hands of a person with acute arsenical poisoning, showing areas of pigmentation and white bands across the nails. See descriptive text in these columns

The Danger of Ethylene

DURING the past few years newspapers have occasionally reported explosions of ethylene gas, so that many directors of hospitals and many people among the public have come to associate the use of this substance with special hazards. Unfortunately the newspapers do not print records of the successful anesthesias with this substance and the point of view becomes badly distorted.

In order to discover the exact state of affairs, Dr. Moses Salzer sent a questionnaire to 478 hospitals to find out whether or not they use ethylene and whether or not they have had explosions during its use. His records indicate that 425,000 ethylene anesthesias had been induced and that there were only 10 explosions—one in every 42,000 cases. Some of these explosions were mere flashes, such as can occur with other anesthetics. There were three instances of minor injuries, four instances of destruction of equipment, and one death. Doctor Salzer is convinced, as a result of his survey, that from the point of view of explosion, ethylene is safer than ether.

Sensitivity to Food

NOT infrequently people suffer from bleeding under the skin. The spots appear suddenly following brief attacks of abdominal pain, sometimes including also the development of blisters and bleeding from the gums. Recently physicians have come to associate the appearance of this combination of symptoms with specific sensitivities to various food substances, the symptoms representing reactions by the body to the ingestion of the food to which the person might be sensitive.

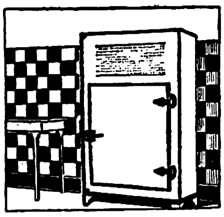
Drs. H. L. Alexander and C. H. Eyermann of St. Louis have recently reported six cases of this type. In one, the removal of milk from the diet resulted in complete recovery. In another, egg, potato, and wheat were the substances involved. Removal of these substances resulted in recovery and feeding of these substances invariably produced the symptoms. In a third case, that of a woman of 32, eggs, chicken, beans, fish, and lamb invariably induced abdominal pain and headaches, and the avoidance of the offending products brought relief from the symptoms.

A boy 14 years of age was sensitive to red plums. A woman 50 years of age developed abdominal pain, bleeding under the skin, and sneezing following the eating of wheat products. Another woman developed abdominal pain, blue spots under the skin, and painful joints following the eating of pork, onions, or strawberries. She invariably remained well while avoiding these foods. Tests made with small doses of the extract material rubbed into the skin revealed the sensitivities.

Many of the unexplainable symptoms of the past are now being brought into the group that is called by the physician "allergy."

A cold place to keep eggs, a warm place to hatch them . . made with this grainless wood

There are hundreds of industrial applications for the grainless wood board, Masonite Presdwood. The Presdwood booklet lists eighty of its uses and may suggest ways in which you, too, can use Presdwood to improve a product or lower manufacturing costs. A sample of Presdwood and a copy of the booklet will be sent, free, on request.



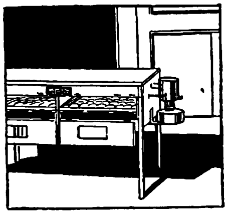
FOR ICEBOX CABINETS

A de luxe ice box, that is made in Detroit; an incubator, which comes from Racine; an outdoor sign from Kalamazoo, advertising baby chicks. These things and scores of others, ranging from tiny toys tc monster motor truck bodies, are now made of this grainless wood, Masonite Presdwood.

For panels, painted or unpainted

The entire outer cabinet of the ice box is made of this grainless material because of its hard, smooth surface on which commercial finishes can be so readily applied. The incubators are made of Presdwood because it is weather resisting, strong, easily punched or cut with any woodworking tools and so naturally attractive that a paint finish is not required.

Carload after carload of Masonite Presdwood goes to makers of signs of all kinds. The sign builder at Kalamazoo is just one of many. He cuts out giant "chicks" as advertisements and sells them to breeders of fancy poultry who wish to advertise their business along near-by roads.



FOR STURDY INCUBATORS

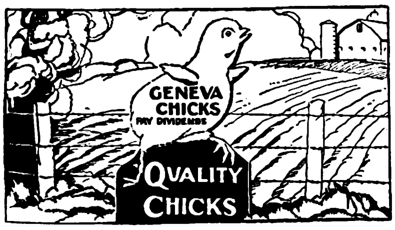
Presdwood is used for scores of other things. It makes smooth beds and rails for portable billiard tables. It makes cooling trays for castings, starch trays for candy factories, bedroom screens, doll houses, toy animals for children to play with. It panels walls and ceilings of fine homes and the offices and corridors of the better type office buildings. Used to line concrete forms it gives such a perfect, smooth surface that the need for hand rubbing and grinding is eliminated.

Send for this booklet

Eighty uses for Presdwood, many of them attractively illustrated, are listed in the Presdwood booklet. It will certainly pay any industrial executive, builder or home owner to get a copy and learn more about the advantages of wood that is grainless. The booklet and a sample of Presdwood will be sent, free, on request.

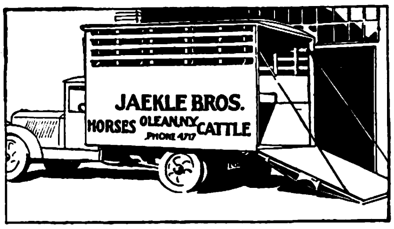
MASONITE CORPORATION
Sales Offices: Dept. 741, 111 West Washington Street
Chicago, Illinois

FOR SIGNS AND CUTOUTS



Masonite PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR MOTOR TRUCK PANELING



© 1929 M. C.

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Hydrogenation Comes to Revolutionize Gasoline Production

WHAT is probably the most significant recent development in the whole realm of industrial chemistry was recently announced by the Standard Oil Company of New Jersey—a revolutionary process for the production of gasoline from petroleum. By ordinary distillation, a gallon or crude oil can be made to yield a certain amount of gasoline. This maximum yield would not produce nearly enough gasoline to take care of the present demand and the motoring public is indebted to Dr. W. M. Burton, who, some years ago, developed the "cracking" process, whereby the yield of motor fuel from crude was greatly increased by breaking down more of the higher hydrocarbons in petroleum to gasoline. Now, however, comes an entirely new process, whereby *all* of the crude oil is converted into gasoline by hydrogenation. Whereas "cracking" is a *destructive* process, hydrogenation is a *constructive* reaction, actually building up gasoline from atoms of carbon and hydrogen.

This revolutionary development was first announced in the pages of *Chemical and Metallurgical Engineering* by S. D. Kirkpatrick, who explains that by this high-pressure, high-temperature, catalytic process, fuel crudes and the heavy residues of the ordinary refining process can be converted almost quantitatively into gasoline or other more valuable petroleum products. A semi-commercial plant has been in successful operation at Baton Rouge, Louisiana, for about a year, and construction is now going forward on the first of two large plants that will compare in output with an average oil refinery.

By the introduction of hydrogen under pressures varying from 100 to 300 atmospheres and in the presence of a catalyst, it is possible to build up or synthesize the hydrocarbons desired and thus to convert approximately 100 percent of the original oil into gasoline or other products of more value. Carbon formation is actually eliminated and the production of fixed gases is reduced to a minimum. Thus the chemical engineer has again demonstrated that in large measure true conservation of our oil resources lies in their scientific utilization. This process alone promises to make more valuable millions of barrels of low-grade fuel oil and residues.

The research program of the Standard Oil Company (New Jersey) has been carried on by the Standard Oil Development Company, both in the company's engineering laboratories at Bayway, New Jersey, and at the Baton Rouge refinery of the affiliated company, the Standard Oil Company of Louisiana.

Organic Substances Reduce Boiler Scale

COMMERCIAL tannin extracts, such as chestnut-oak, are efficient in removing dissolved oxygen from boiler waters and thereby controlling corrosion in many cases, according to A. H. Reynolds of the Dearborn Chemical Company who presented a paper on the subject before a recent meeting of the American Chemical Society. Boiler pressures up to 130 pounds do not destroy this oxygen-absorbing power.

Operating results, according E. M. Partridge of Paige and Jones Chemical Company, also show that harmful scale formation may be prevented at low cost through the use of organic matter in conjunction with quantities of inorganic chemicals far below the amounts necessary to react chemically with the scale-forming constituents of the feed water. The organic matter possibly acts in such a manner that the calcium sulfate and other solid materials formed during evaporation are kept in suspension rather than carried down as a sludge. The best results have been obtained by combining the lime-soda softener with the organic material treatment.

Investigate "Spotting" of Electroplated Metals

MANY electroplated products, especially those that are plated with brass or are given an "oxidized" finish, show a tendency toward the development of dark, unsightly spots on the surface. This defect, commonly known to the platers as "spotting out," has at times proven very serious in certain industries, such as the manufacture of builders' hardware. The American Electroplaters' Society, composed of foremen electroplaters, collected from their members and from firms engaged in plating, funds for researches on electroplating at the United States Bureau of Standards, and selected "spotting out" as the first problem for study.

The investigation has shown that there are two entirely distinct types of spotting. The "crystal spots" appear as dark radiating crystals upon metals that have a finish of copper sulfide (the so-called "oxidized" finish), and that are subsequently lacquered. The "stain spots" appear principally upon cast metals in the form of irregular areas of variable color.

The crystal spots are caused by the absorption of minute amounts of sulfur or sulfur compounds from the surroundings. Free sulfur (which may be used in certain plant operations), rubber bands, or wrapping paper or cartons containing small amounts of sulfur may cause this defect to develop. The only effective remedy is (1) the application of a lacquer which is nearly impervious to sulfur; (2) the application of a very thin film of grease to the lacquered surface, and (3) the use of waxed paper for wrapping the articles.

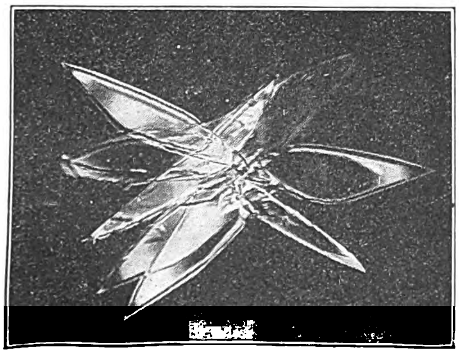
The stain spots result from the presence of minute pores in the metal, and the absorption in these pores of chemicals, either acid or alkaline, during the operations of cleaning and plating. When such articles are subsequently exposed to an atmosphere with high humidity, moisture is absorbed by the materials in the pores, which then exude and stain the surrounding metal.

Some improvement can be made by using less porous castings and by allowing the chemicals to "spot out" from the pores before the final finishing. The most effective remedy is the application of such lacquers as have been found to retard or prevent the spotting.

Investigate New Sources of Potash

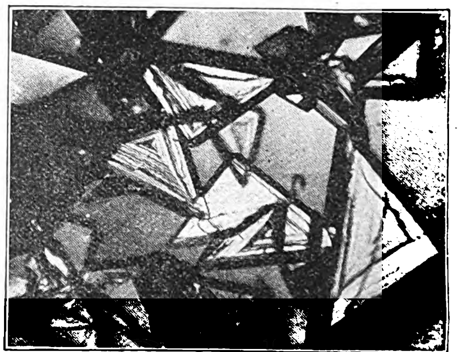
WITH the passage by Congress of the Winter bill during the past session, the way is open for a further extension of investigations into the potash resources of the country, according to the United States Bureau of Mines, Department of Commerce. Previous governmental investigations had been limited to the exploration for potash deposits in Texas and New Mexico, which geological data indicated as being present but which had not been proven. By the provisions of the Winter bill, investigations are authorized to cover other potash minerals, such as the leucites and alunites, greensands, and other potash ores.

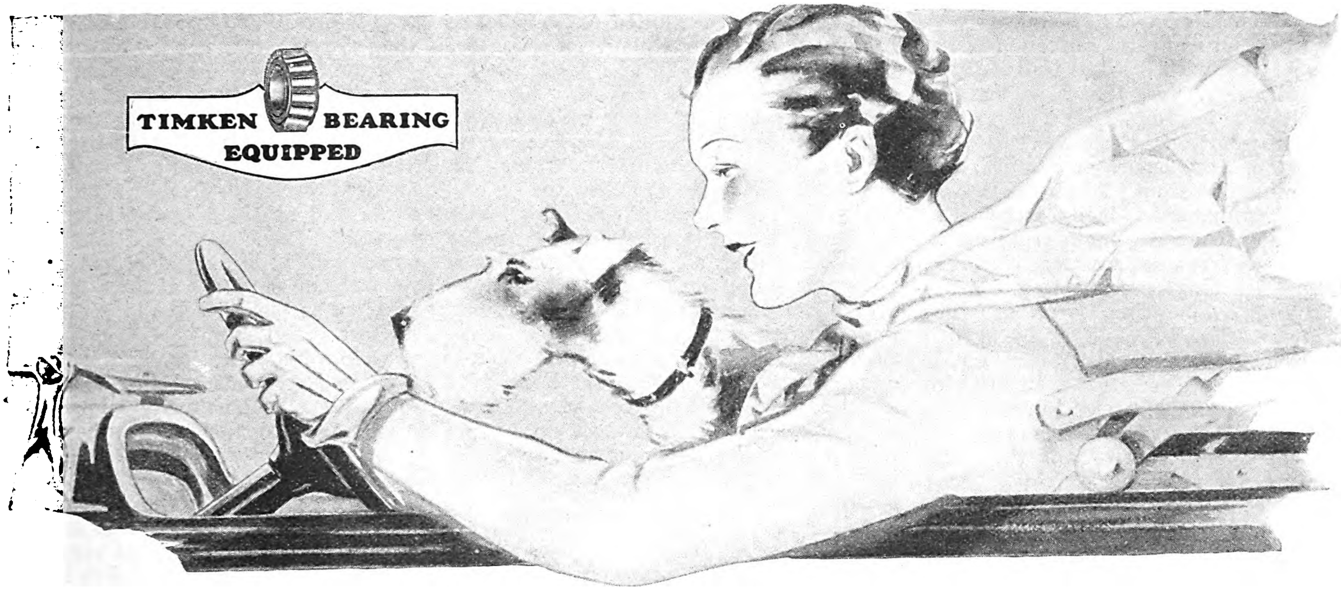
In order to carry out research on the extraction of potash from leucite, alunite,



ABIETIC ACID CRYSTALS

These pictures, reminiscent of the view through a child's kaleidoscope, are photomicrographs of abietic acid crystals "grown" under different conditions imposed by the chemist. The triangular crystals at the right were formed from an alcoholic solution, and the flower-like cluster at the left was "grown" in rosin of high acid number





CARS THAT STAY YOUNG

Go . . . . fast or slow . . . . youth yearns to burn up distance . . . . but what is distance to Timken-equipped cars?

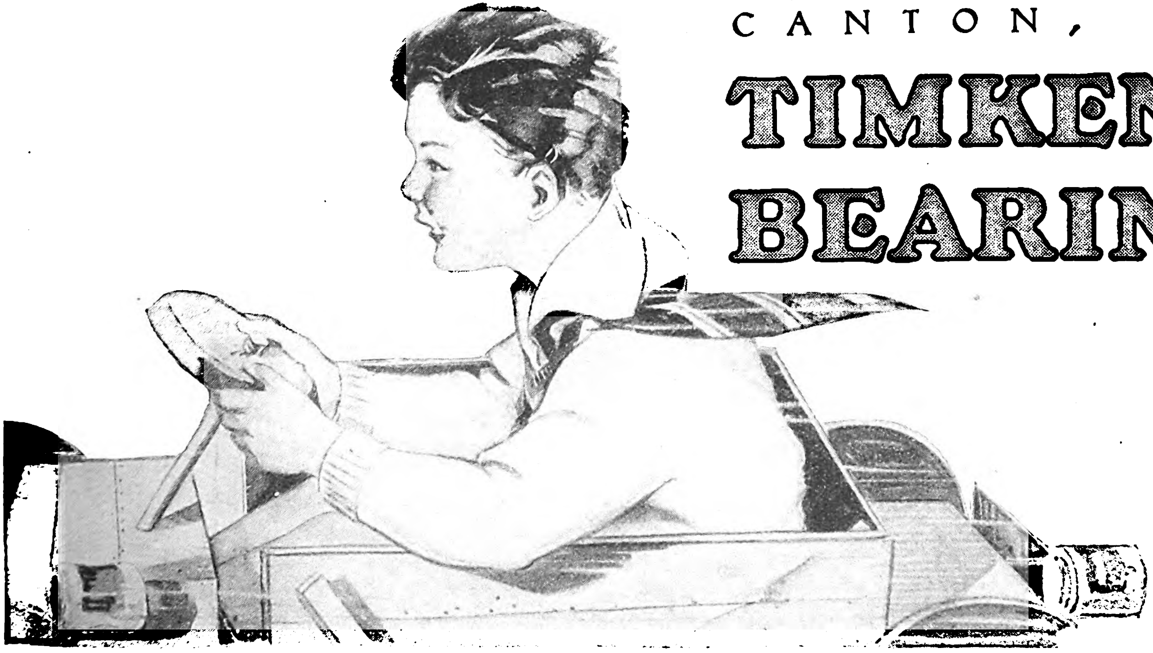
Noise is stilled, gears and shafts run true and miles leave only speedometer totals to mark their passing.

Abiding car youth is founded upon this exclusive combination: Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

Would you have Cars That Stay Young? Make sure of "Timken Bearing Equipped" in differentials, pinions, transmissions, wheels, steering pivots and fans.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN ***Tapered Roller***
BEARINGS



and other potash-bearing minerals, the Nonmetallic Minerals Experiment Station, of the United States Bureau of Mines in co-operation with Rutgers University at New Brunswick, New Jersey, is enlarging its facilities to include work on leucite and alunite in addition to the work now in progress on New Jersey greensands, and saline minerals from Texas and New Mexico. Equipment is being installed to conduct unit chemical engineering operations such as crushing, roasting, clacining, digesting, leaching, precipitating, clarifying, filtering, evaporating, et cetera. The scale of operations is the next stage beyond that of the chemical research laboratory. It is designed to be the smallest scale in which the processes can be carried out with the same materials and with the same type of equipment as would be used in the large-scale plant.

Chemistry Contributes to Improved Explosives

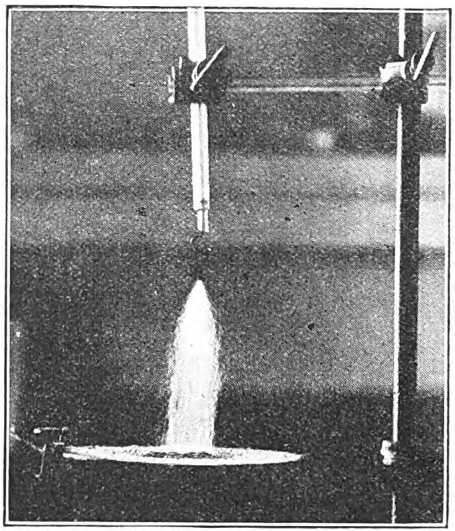
We seldom stop to consider the many uses of explosives in producing the materials and conveniences of modern civilization. In mines and quarries, vast quantities of industrial explosives are used to blast ore and rock from its native source, while modern road and building construction is largely dependent upon the effectiveness of dynamite. Even the up-to-date farmer uses explosive to remove stumps and dig ditches. Because of the varied applications of the product and because the manufacture of explosives is so thoroughly dependent upon chemical science, the chemist finds a fertile field for his genius in research work in the explosive industry.

Ammunition for the Army and Navy and for sportsmen also constitutes a steady market for explosives. Since the World War, many improvements have been made in the quality of smokeless powder.

One of the important developments in dynamite manufacture is the production of low-freezing explosives which has greatly increased the safety factor in the mining industry, according to Dr. Charles E. Munroe, chief explosives chemist, United States Bureau of Mines, Department of Commerce. Frozen dynamite is a most objectionable and dangerous substance, for the frozen sticks or cartridges tend to become rigid, Dr. Munroe points out. For loading into boreholes it is desired that the dynamite sticks shall be plastic so that they may be readily pressed into place. There is also the likelihood that rigid sticks may be ignited or exploded by friction against the walls if forced into a borehole.

Frozen dynamite is difficult to detonate. Hence a grade of detonator which is quite capable of firing the unfrozen dynamite, and may be depended on to fire it, may not fire frozen dynamite at all, so that a misfire, with all its attendant evils, may result, or it may cause a partial explosion, or burning, giving off large quantities of poisonous fumes into a mine. Naturally such shots are not only a total loss, but, more than that, they are a source of additional expense and of danger. Consequently, users of dynamites have been strenuously warned against using frozen dynamite and advised to store their dynamite in such a manner as to prevent its becoming frozen, or if it became frozen, to thaw it before use.

As has repeatedly been found true in the development of many inventions, all this time simple means for the prevention of dynamite freezing were right at hand. The principle was well understood and widely applied, even in domestic operations. And when the method was worked out and successfully applied to dynamites it was so obvious as to excite wonder that it had not been applied years before. The principle is made use of in freezing ice cream mixtures where a lower temperature than the freezing point of water is sought and is obtained by putting common sea salt on the ice used.



Courtesy Hercules Powder Co.

Man-made lightning is directed on smokeless powder to determine its sensitivity to static electricity

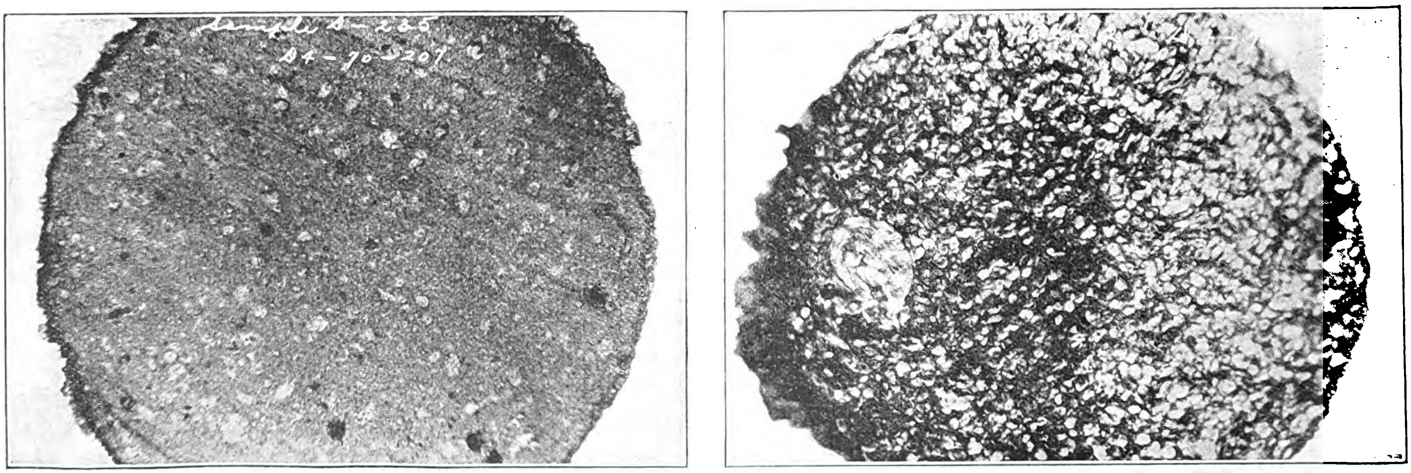
It is common knowledge that when sea salt is dissolved in water the temperature of the liquid falls below the freezing point of water and that a lower temperature is required to freeze this salt water than is required to freeze fresh water. A great variety of other inorganic salts, such as potassium carbonate, calcium chloride, ammonium chloride and others have been similarly observed to cause a fall in temperature as they dissolve in water, each to its own point, some of them producing very low temperatures, and in each case the freezing point of the solution thus formed was proportionately low. Further observations demonstrated the fact that this behavior was not confined to water but extended to many liquids, and that it was not confined to inorganic salts but that it extended to many organic compounds.

That this is a principle of very wide application became apparent but its use for the reduction of the freezing points of explosives came about rather by chance observation than through the systematic application of the principle.

By the beginning of the present century the explosives industry had attained large proportions. It was looked upon as a very profitable industry and many inventors were inspired to discover new explosive substances or to prepare new explosives combinations that they might share in this prosperity. About 1902 much interest began to be taken in the use of the trinitrotoluenes as military explosives. In the nitrating of toluene a considerable amount of tarry liquid residue was produced which the manufacturers were ready to dispose of at almost any price, and as it was cheap, apparently abundant, and possessed some moderate explosive qualities, the thought occurred of incorporating some of it into dynamite dopes. The resultant dynamite developed good qualities and in its use it was observed that it did not freeze under the conditions when other dynamites in use froze. It was not long after this that low freezing dynamites, designated as L.F., and containing "liquid nitrotoluenes" as a component, appeared in the market.

With the outbreak of the Great War, the nitration of toluene became so perfected that the "liquid nitrotoluenes" were no longer available for use in dynamites. Moreover a growing shortage of glycerin

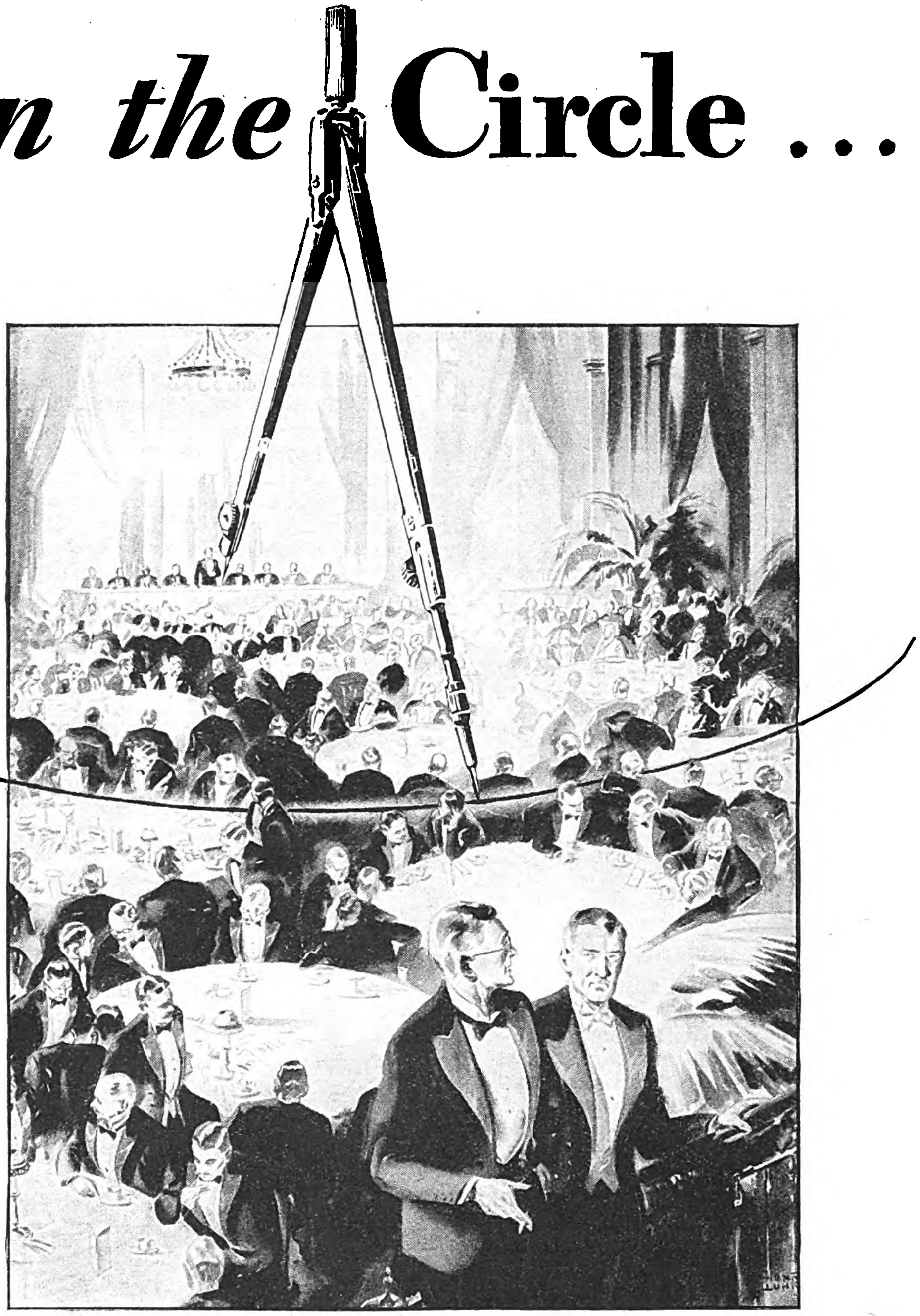
(*Please turn to page* 260)



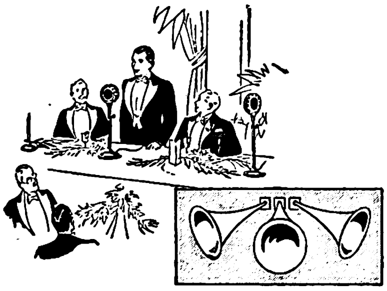
Courtesy Hercules Powder Company

Cross sectional view of grains of smokeless powder, magnified approximately 100 times. Research has resulted in improved explosives since the World War, and high explosives are now handled with less danger

Widen the Circle . . .



Let the people in the *rear* seats HEAR



EQUIP a convention hall or large dining room with the Western Electric Public Address System, and you enable the entire gathering to hear the speakers with equal ease.

This product of the telephone amplifies sound and distributes it to all sections of a crowd, indoor or outdoor, and to any number of rooms desired.

More and more hotels are turning to the Public Address System as a means for making their meeting rooms more popular. It is moreover a medium of economy because it permits a single orchestra to play at the same time in restaurant, grill, lobby, and everywhere else that loud speakers have been installed.

The apparatus which thus "widens the hearing circle" is made with all the skill and care which have so long characterized the manufacture of telephones and communications apparatus by Western Electric. It is clear toned, faithful in reproduction, dependable, modern. It has a wide variety of uses and is made in sizes to fit every need.

Healing by music—a service of the Public Address System in hospitals.

One of many interesting uses of Public Address in the schoolroom.

Western Electric

PUBLIC ADDRESS SYSTEMS

DISTRIBUTED BY GRAYBAR ELECTRIC COMPANY: OFFICES IN 72 PRINCIPAL CITIES

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

OFFICIAL AVIATION GUIDE is a new monthly bulletin presenting official up-to-date data regarding the nation's airways. It is a clearing house for information concerning the passenger and transport lines, and contains detailed time tables, schedules, routes, fares, and incidental information. *John R. Fletcher, Publisher, 105 West Adams Street, Chicago.—50 cents.*

FLYING PIONEERS AT HAMMONDSPORT, NEW YORK, is an attractive illustrated booklet designed to show the part played by Hammondsport and the Finger Lakes region in developing aviation from a hobby to its present state of importance. The pioneer work of Glenn H. Curtiss, and various groups of his associates, is graphically presented. The epoch-making contributions of Samuel Pierpont Langley are described, leading up to some of the more recent achievements in international aviation. *Better Hammondsport Club, Hammondsport, New York.—Gratis.*

Building Construction

TRANSFORMATION — FROM AN OLD HOUSE TO A NEW HOME is a well-illustrated "before and after" explanation of adaptable methods of restoring and enhancing dilapidated old houses at small cost. *National Lumber Manufacturer's Association, 702 Transportation Building, Washington, D. C.—Gratis.*

FACTS ABOUT THE STRUCTURAL STEEL INDUSTRY gives some interesting historical facts about the fabricating industry, traces the historical development of steel and iron, lists a dozen advantages of structual steel, and provides informative comparisons of the world's great buildings and bridges. *American Institute of Steel Construction, Inc., 200 Madison Avenue, New York.—Gratis.*

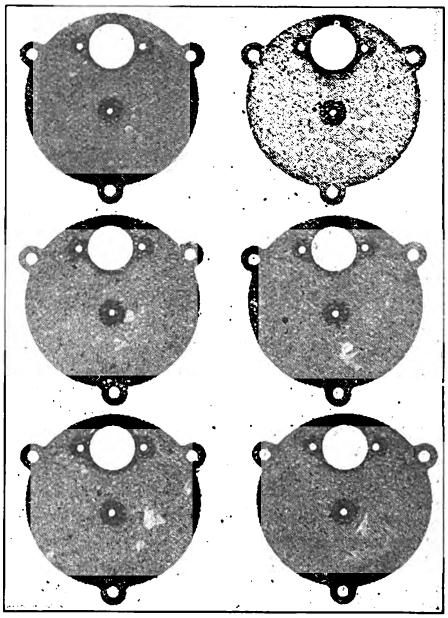
BUILDING IN THE ELECTRICAL AGE is a handsomely illustrated booklet showing the types of electrical equipment used in buildings of various kinds. Skyscrapers, all kinds of office buildings, hotels, theaters, public buildings, apartments, stores, hospitals, schools, churches, newspaper plants, and homes are represented. *Westinghouse Electric and Manufacturing Company, 195 Broadway, New York City.—Gratis.*

Electricity

THE WESTINGHOUSE LIGHTING INSTITUTE tells the story of the Institute recently established "to the end that Industry and Commerce may be benefited by the advantages that accrue from the adequate and proper use of lighting in their respective fields, and people in all walks of life may be afforded greater comfort, health, and happiness through a wider dissemination of knowledge respecting the possibilities and correct application of illumination to their needs." *Westinghouse Lighting Institute, Grand Central Palace, New York City.—Gratis.*

HOME MADE STATIC AND HOW TO AVOID IT, is devoted to the cause and cure of "man-made static," which causes much unnecessary interference with radio reception. Everyone who operates a radio set will find the booklet both interesting and helpful. *Radio Manufacturers Association, Inc., 11 West 42nd Street, New York City.—25 cents.*

X RAYS IN INDUSTRY is a booklet which shows the value of X rays for determining the internal structure of such objects as castings, bearings, radio tubes, telephone poles, and an endless variety of manufactured products. The fundamentals of radiography are explained briefly and non-technically. *Eastman Kodak Company, Rochester, New York.—Gratis.*



Radiographic examination of small die castings, revealing shrinkage flaws, hard spots, and gas inclusions, detected with the X rays

Safety

FIRST AID MATERIALS, Catalog No. FA-1, will assist all who are interested in safety appliances and first-aid equipment, especially in mines, factories, and other industrial establishments. *Mine Safety Appliances Company, Pittsburgh, Pa.—Gratis.*

SAFETY IN THE AIR, by Harry F. Guggenheim, is a brief paper scanning the aviation industry from the standpoint of safety. Similar papers are SAFETY ON THE HIGH SEAS, by Joseph E. Sheedy, and SAFETY AND THE WORKER, by James J. Davis. The series was presented by radio through the coast-to-coast chain of stations associated with the National Broadcasting Company. *National Safety Council, 108 East Ohio Street, Chicago.—Gratis.*

LEAD, HEALTH PRACTISES PAMPHLET NO. 3, is a valuable compilation of practical information regarding lead poisoning in industry. The importance of adequate understanding of the problems of lead exposure is shown by the medical records. Lead is now used in 150 trades and is constantly finding new applications. Many employers and workmen have failed to appreciate the insidious character of lead poisoning. *National Safety Council, 108 East Ohio Street, Chicago.—Gratis.*

THE SKY'S THE LIMIT is a well-written argument against the smoke nuisance, showing that an effective means of clearing the atmosphere is by burning gas, coke, and other "smokeless" fuel. *American Gas Association, 420 Lexington Avenue, New York City.—Gratis.*

Miscellaneous

AGRICULTURE YEARBOOK FOR 1928 includes short articles regarding recent developments in agricultural science and practise, and non-technical descriptions of all aspects of farming from soil preparation to marketing. The book also contains the annual report of the Secretary of Agriculture, and the customary compilation of agricultural statistics. Charts, maps, special indexes, and cross references add to the book's value. *United States Government Printing Office, Washington, D. C.—$1.50.*

SECOND BULLETIN OF THE INTERNATIONAL COMMITTEE FOR BIRD PRESERVATION, reports the progress made to date in extending and co-ordinating the activities for conserving the wild bird-life of the earth. The bulletin is a chronicle of the recent Geneva Conference, attended by representatives of the various national societies devoted to the preservation of birds. *T. Gilbert Pearson, Chairman, National Association of Audubon Societies, 1874 Broadway, New York City.—Gratis.*

RECENT ECONOMIC CHANGES IN THE UNITED STATES, is the title of the report of the President's Conference on Unemployment, which recently completed a nationwide survey to appraise the changes that have taken place in economic conditions in the United States since the World War. An appendix contains an outline of the report. *United States Government Printing Office, Washington, D. C.—5 cents.*

A Most Important Announcement

TO THOSE INTERESTED IN

PATENTS

* * *

WALKER

on the

LAW OF PATENTS

6th EDITION in 2 VOLUMES

ENTIRELY REVISED AND ENLARGED

by

JOHN L. LOTSCH
Member of the New York Bar

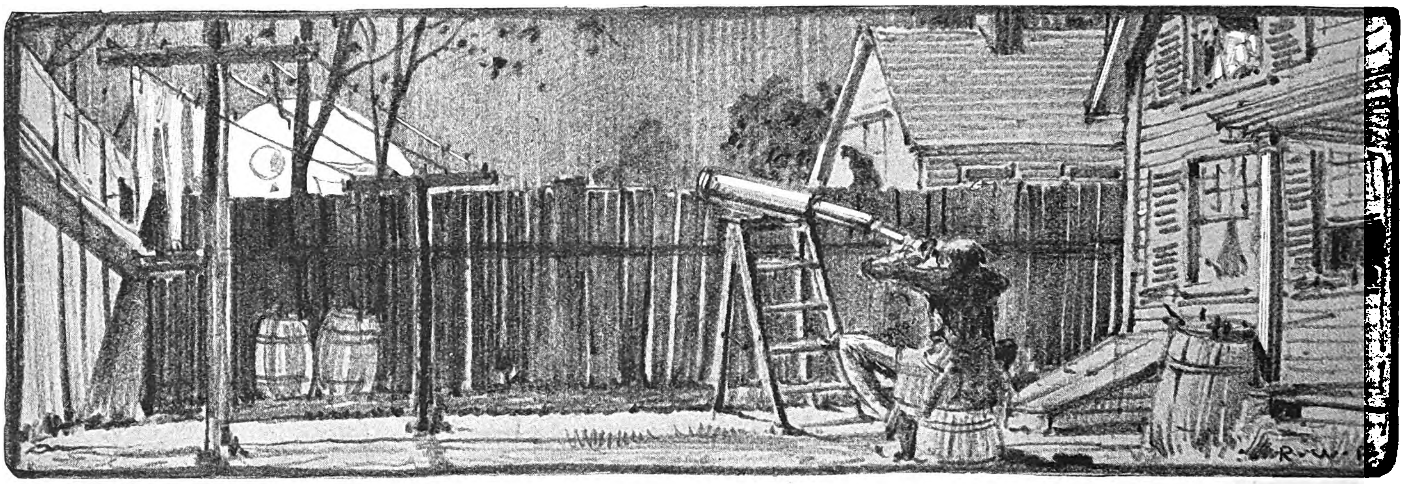
* * *

In this edition Mr. Lotsch has not only thoroughly revised the text of the original work of Mr. Walker, but he has added, as a second volume, a complete digest of all patent cases decided by the United States Supreme Court, and by nine Circuit Courts of Appeals of the United States, as well as many practical pleading forms of great value.

* * *

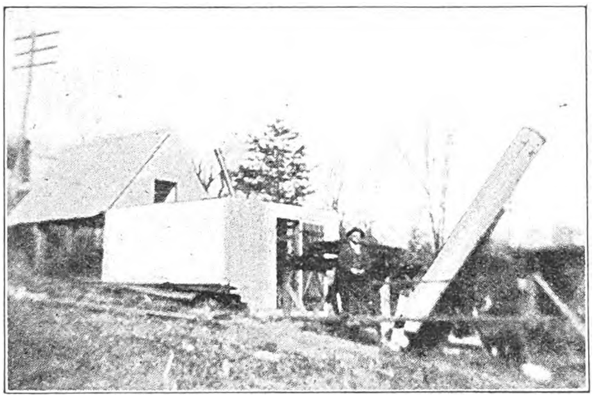
BAKER VOORHIS & CO.

119 FULTON STREET ·:· NEW YORK, N. Y.



The Amateur Astronomer

G. W. NORVELL, a telegraph operator at Covesville, Virginia, has made a 16-inch telescope with a solid tube that looks like one of the large-caliber guns on a super-dreadnaught. In addition, he has made two 10-inch mirrors and the mounting for a 6½-inch refractor. The two pieces of armament show in the accompanying photograph. The observatory for the refractor has a sliding gantry roof, an easy type to construct.



Mr. Norvell and his telescopes

"I am sending you," Mr. Norvell writes, "a snap shot of my 16-inch reflector. The mirror was made of inch and one half glass. I took my time and did not let the surface get scratched, nor did I have difficulty with sticking. I did have quite a time landing a good correction on the glass but I had previously made two 10-inch mirrors and this helped wonderfully.

"I ground the mirror to a focal ratio of 11 to 1. This is quite long, but it gives a fine flat field, and when seeing is good it is hard to beat. The glass shows no flexure but I would not advise anyone to attempt a larger mirror with such thin glass. Anyone who wishes to try a 16-inch will surely have to be careful, as it is altogether more of a job than a 10-inch.

"I can see with the telescope white objects, looking like foam, on the sun; also good markings on Mars; Jupiter's fine markings from pole to pole; and Saturn's rings and divisions.

"The tube is 16 feet in length and 19 inches in diameter. The mounting is made of pipe; the polar axis is 4-inch pipe turned in a lathe to fit a brass box. The whole outfit is set in concrete. It took 215 pounds of old babbit metal to provide a heavy enough counterweight.

"You will notice I have a sliding roof over my refractor, running on balls.

"I do not know what I shall try next, but am thinking of attempting a spectrohelioscope."

FRANK L. WATTS, Box 637, Silvis, Illinois, has made a Cassegrainian telescope. Mr. Watts writes as follows:

"Enclosed is a photo of my 6-inch Cassegrainian telescope. This is my first attempt at making one of this type. The small convex mirror gave me some little trouble in correcting but I succeeded in the end, so that the best of definition is had.

"I get nearly as good results with this as with my 9-inch Newtonian reflector, and fully as good as with my 6-inch refractor. Owing to the long focal length the image is better near the edge of the field than in either of these other telescopes.

"In correcting for figure I did all the testing with a 10-inch flat, and find this gives far better results than by the ordinary method.

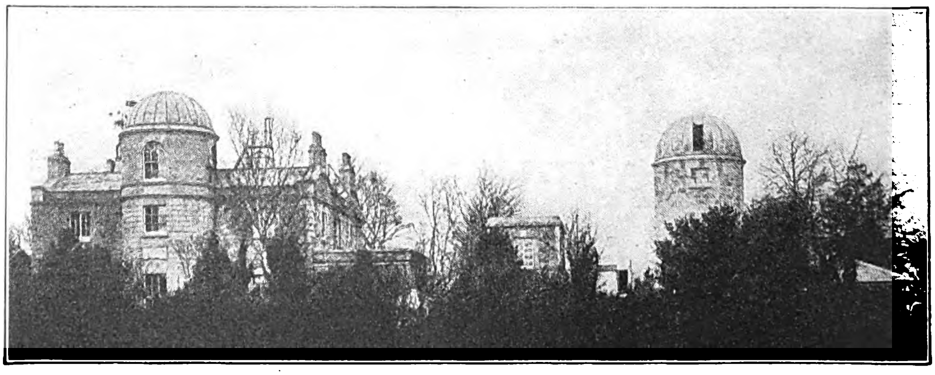
"I have interested several parties in this work and expect to build a 16-inch. I have a well equipped shop and will be pleased to help anyone wishing to build a telescope.

"I wish to thank you very much for aiding me, through your literature."

BELOW we quote a fragment or two from a recent letter from Reverend W. F. A. Ellison, author of the original book "The Amateur's Telescope," most of which is now embodied in "Amateur Telescope Making." Last autumn the Telescope Editor spent a most interesting day with Ellison at the Armagh Observatory in Northern Ireland. A photograph of this delightful old place with its surrounding parks of yew trees and shrubs is reproduced in these columns. The Observatory was built about 1790 and is now used as a residence. It also houses a number of old telescopes and transits which are now curiosities. Carefully put away in a box was a neat brass reflector, about a 6-inch, used by King George III, who was an amateur astronomer. The two modern observatory domes do not show in the picture. One houses a 10-inch, the other an 18-inch, reflector; both of which are used by Ellison. He also maintains a government meteorological station.

One corner of Ellison's workshop building, a thick-walled stone structure, is visible at the extreme right. As one might safely anticipate, this work room in which the superlative Ellison mirrors are made by hand, was utterly simple—no complicated apparatus, no "patent dingbats," no pretension. The testing stand was as plain as one which might be built to test a single mirror. Of course, an expert's main stock of "apparatus" is under his skull. Reverend Ellison stated that he has now completed 140 mirrors, instead of the 70 mentioned in A. T. M. (page 73).

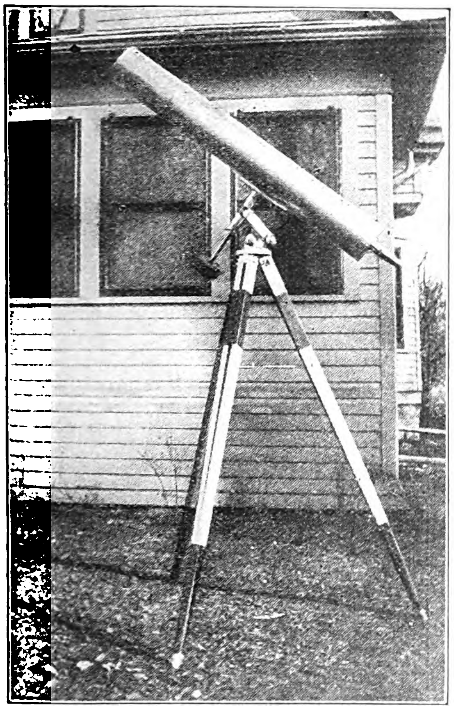
To visualize this mentor of the amateurs the reader may think of a tall, large-framed,



Armagh Observatory in Northern Ireland

striking individual of about 50, with swarthy black beard, dressed in the cloth of the clergyman, with the leggings, the low broad hat and other habiliments of the protestant "Church of Ireland." He, it turned out, is also an expert organist, and his performance on the great electric organ of the Armagh Cathedral was equal in quality with his performances on optical surfaces.

Rev. Ellison writes: "I am afraid your people over there have gone ahead of my reach altogether. If I started the movement, I was like the small boy that rolled a stone down the mountain and started an avalanche. So, far from landing a lovely job like your Mr. Porter I am sometimes afraid 'The Amateur's Telescope' has knocked the bottom out of my market. Still, I am glad to think I have helped so many folks. Tell Mr. Porter, as well as the rest of the brotherhood of 'C. P. R.' (that is, not Canadian Pacific Railway, but 'Carborundum, Pitch and Rouge') that I wish 'more power to their elbows,' and I hope they will not forget the fellow who set the ball rolling.

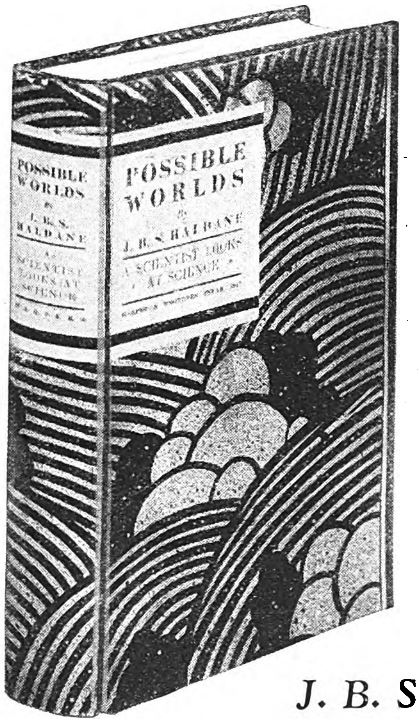

Mr. Watts' telescope

"The real difficulty about 16- and 21-inch jobs is in the mounting and using. I know from my experience with an 18 inch that observing with a 21 inch is no picnic." (Later we shall explain this.—*Ed.*)

RECENTLY several have asked why we did not pay more attention to observations and things actually done with the telescopes already in use by amateurs. One reason is that we lack the space to publish them in the magazine. We shall, then, confine ourselves in this department more to the mechanical end of the work and we suggest that descriptive observations be submitted to our esteemed contemporary, *Popular Astronomy* (Northfield, Minnesota). That journal has recently started a special department for amateur observers. These reports of such observations should be condensed as much as possible.

One type of "observation" which does

(*Please turn to page* 262)



Is One Year of Your Life Worth $2.50?

Bruce Gould, in the *New York Evening World*, says, "It is worth one year of the life of all but perhaps a thousand people in this country. By that we mean that the rest of us could well afford to die a year earlier in exchange for the privilege of sharing the mind of Haldane only in so far as it is revealed in this book. Whatever we would do with that year will not be as important as reading—"

J. B. S. Haldane's

POSSIBLE WORLDS

Dr. George A. Dorsey "found it unbelievably fascinating"

"In this book England's distinguished young scientist has given us forty short studies on as many interesting subjects, including for example, Darwinism Today, Vitamines, Man as a Sea Beast, Water Poisoning and Salt Poisoning, Blood Transfusion, The Future of Biology, Some Enemies of Science, and so on, covering questions of real importance to the layman. There is not a dull page in the book, as might be expected since it comes from the pen of this brilliant writer on modern scientific problems. It has been truly remarked of Haldane that he is one of those rare people who combine scientific accuracy with a highly stimulating literary style."—*Maynard Shipley.*

And do you own the

Four Keys to Science

1. THE NATURE OF MAN
By George A. Dorsey, Ph.D.
Man and his reactions in society by the author of "Why We Behave Like Human Beings."

2. THE LAST JUDGEMENT
By J. B. S. Haldane
Mr. Haldane looks ahead some forty million years and describes the possible end of our planet.

3. THE STREAM OF LIFE
By Julian Huxley
The modern trends of biology brilliantly and simply explained.

4. WHAT IS THE ATOM
By E. N. deE. Andrade, D.Sc., Ph.D.

$1.00 a KEY—$6.50 for FOUR KEYS and a YEAR OF LIFE

HARPER & BROTHERS S. A. 9-29
49 East 33rd Street, New York City

Gentlemen: Please send me

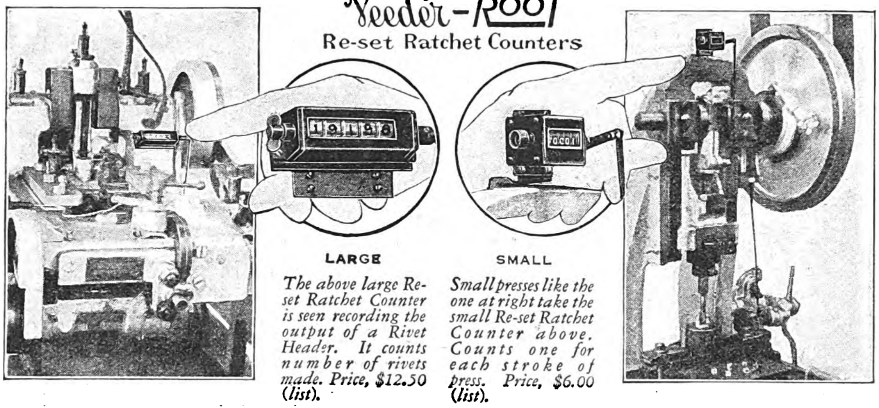
☐ Possible Worlds
☐ The Nature of Man
☐ The Last Judgement
☐ What Is the Atom
☐ The Stream of Life

Name...Enclosed Find.................

Address...Send C. O. D.................

Make Machines *Self-Managing*

Veeder-ROOT
Re-set Ratchet Counters



LARGE

The above large Re-set Ratchet Counter is seen recording the output of a Rivet Header. It counts number of rivets made. Price, $12.50 (list).

SMALL

Small presses like the one at right take the small Re-set Ratchet Counter above. Counts one for each stroke of press. Price, $6.00 (list).

Let capacity output be assured—automatic—*part of the machinery* so far as possible. Let the operator see what the pace should be, and hold his machine to its high mark continuously. The Counter gets this *sustained work.*

The machine that records its production *manages itself.* Gets the attention it needs; gives the output *you* need. If the work slows down, the fact goes down on the Counter. It tells the operator to get busy. *Ask for Catalogue.*

Counters for your office machines, too. Let us send literature.

Veeder-ROOT INCORPORATED
HARTFORD, CONN.

OFFICES IN PRINCIPAL CITIES; WRITE OR PHONE

PATENT FOR SALE

BRAZING or SOLDERING TOOL—Patent No. 1,588,761. WILL SELL OUTRIGHT, ON ASSIGNMENT, OR ROYALTY BASIS. Address LIGOT, Box 192, SCIENTIFIC AMERICAN, New York.

MONEY

MYSTERY GAS LIGHTER

JUST OUT, LIGHTS GAS INSTANTLY WITHOUT SPARKS OR FLAME - SELLS LIKE WILDFIRE WHEREVER GAS IS USED —RETAILS FOR 25¢

MAKE $25. A DAY

1 SAMPLE FREE -

PACKED ON INDIVIDUAL CARDS WITH INSTRUCTIONS

RUSH $10.00 FOR GROSS OR 1.00 FOR DOZ.

NEW METHOD MFG. CO.
Desk SA-9 Bradford, Pa.

MONEY

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

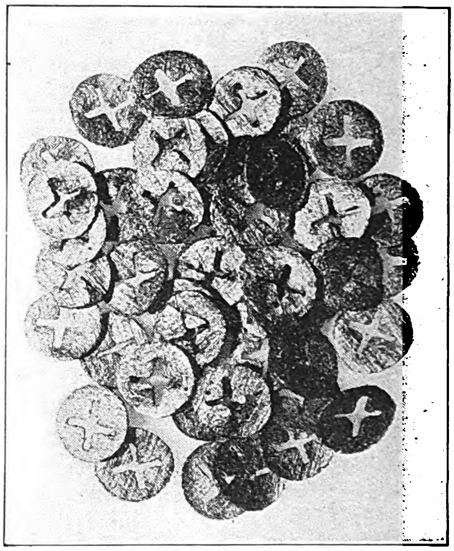
Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

Chemistry in Industry

(Continued from page 254)

necessitated the use of substitutes. In this event sugars, such as cane sugar and glucose, were dissolved in the glycerin and nitrated with it and the sucrose and glucose nitrates thus produced, were found to depress the freezing point of the "nitroglycerin." Later polymerized glycerins, in which the residue of two or more molecules of glycerin had coalesced to form larger molecules, were dissolved in the glycerin and nitrated with it, the nitrated polyglycerins serving admirably to depress the freezing point of the nitroglycerin.

The latest depressant used is ethylene glycol dinitrate. Its introduction was determined to an extent by economic reasons, but it serves well the purpose and possesses additional characteristics of value. The ethylene glycol, which is mixed with the glycerin before nitration, is synthesized from natural gas and there is every reason to believe that the available supply will prove abundant for many years.



Courtesy Hercules Powder Co.

Not Chinese coins, but grains of smokeless powder, extensively used in building and construction work

New Protective Coating Has Rubber Base

A NEW protective coating marketed under the name of "Rubalt" has been placed on the market by Alfred Hague and Company of New York. This material is composed of rubber, bitumen, and benzol and is said to be highly resistant to mineral acids, alkalies, chlorine, ammonia, brine, and other chemical media. The coating is ordinarily black, although one grade is made in a number of colors. The colored grade is not in general as successful with powerful corrosive agents as the various grades of black material.

Smoke Encourages Pneumonia

THE pneumonia ratio in congested urban centers is in direct proportion to the smoke density, says Professor S. W. Parr of the University of Illinois and President of the American Chemical Society, who is making a careful study of the use and conservation of fuels in the United States. He states that:

"The more smoke, the more pneumonia;

the less smoke, the less pneumonia. The accentuation of the smoke evil in large industrial centers has set in motion various investigations looking to abatement. Sooner or later these studies lead back for a solution to the carbonization of coal and the use of smokeless fuel in some form. When gas reaches the stage of volume production, it will be the most powerful influence in ridding our cities of the smoke mask which now ruins our health and damages our property."

Fluorine Commercially Produced

MEMBERS of the American Electrochemical Society, attending a recent convention, were the first to hear of the startling research carried out at Cornell University by Professors Wilder D. Bancroft and Newton C. Jones on the production of the rare gas, fluorine, in commercial quantities of a thousand cubic feet at a time. Although fluorine has been made in very minute quantities in a few laboratories in years past, and has at those times excited the interest of the investigators, it has never been possible in the past to collect sufficient quantities of this interesting, yet very elusive, gas to allow the scientists to investigate thoroughly its characteristic properties.

Fluorine is not an uncommon element, and occurs in large quantities in various parts of the earth's crust, combined chiefly with calcium, as fluorspar. But to free the fluorine from its combination with other elements has been an extremely difficult feat, and it was not until about three years ago that Professor F. C. Mathers of the University of Indiana pointed out the way that has lead to the remarkable development and results of today. Due to the very specific nature of fluorine, it being the most active of all the elements, an entirely new chapter of chemistry has been opened. For example, the reaction of fluorine gas with benzene proceeds explosively, a result which is most surprising on the basis of the little information regarding the properties of the gas heretofore available.

Caustic Soda Made by Use of Fluorine

CAUSTIC soda, one of the most important commercial chemicals, is ordinarily made by an electrolytic process which is well established and efficient. German chemists, however, apparently refuse to believe that there is any chemical process which cannot be improved upon and have worked out a novel method for caustic soda manufacture which they believe to have commercial possibilities.

Briefly, the process involves the production of caustic soda from salt and calcium carbonate by the use of fluorine compounds, which are constantly regenerated. The steps are: (1) To an acid solution of sodium chloride, containing precipitated CaF_2 from a third manufacturing step, is added gaseous SiF_4 from the second step. The product is a firm sodium fluosilicate which is filtered out. (2) The fluosilicate is broken down at 700 degrees, Centigrade, to NaF and SiF_4, which is utilized in step one. (3) NaF is converted to caustic soda by addition of milk of lime, a further product being the CaF_2 used in step one.

The basic idea of the process dates to 1858, but with its numerous present improvements the promoters of the process claim that the only problem that remains now is that of efficient equipment.

. . . IT CONTRIBUTES TO THE PROSPERITY OF THE PEOPLE AND TO THE COMFORT AND CONVENIENCE OF LIVING

The telephone grows with the country

An Advertisement of the
American Telephone and Telegraph Company

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

THE Bell System must march a pace ahead of the new civilization on this continent, a civilization of better opportunity for the average man. The telephone contributes to the prosperity of the people and adds to the comfort and convenience of living.

It is used by the many. The time and money it saves are as important to the small business as to the large. The humblest home depends on it for aid in emergency, to run errands, maintain friendships. It is the aim of the Bell System to keep telephone service so good and so cheap that it will be used universally to make life richer and better. It seeks to lead the way in social and business growth. It is raising buildings this year in more than two hundred cities, adding vast mileage to the expanding network of cable, and installing new telephones by the hundreds of thousands.

It is spending more than 550 million dollars this year—one and one-half times the cost of the Panama Canal—for new plant and service improvements. This program is part of the telephone ideal that anyone, anywhere, shall be able to talk quickly and at reasonable cost with anyone, anywhere else. There is no standing still in the Bell System.

S AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

Earn More Money in California!
$40 to $75 a week for Auto Men

Don Sterling makes $75 a week, Victor Wright, $60 a week, Paul Briggs, $4000 a year—all because of National training. Big opportunities for you, too, in California. National will train you in a few weeks as auto mechanic, electrician salesmen, etc., to fill big pay jobs now open—$40 to $75 a week. Million dollar school established 1905, thousands of successful graduates. New method of practical shop training insures your success.

EARN WHILE YOU LEARN

Our free employment service finds you a spare-time job, if you wish. You can earn while you learn.

FREE Auto Book

FREE! Special $75 course in salesmanship and garage management, for limited time only. Mail postal or write for big free eighty-four page auto book, with 150 illustrations—gives all facts.

NATIONAL AUTOMOTIVE
Dept. 801-AC, 4004 South Figueroa
Los Angeles, California

ELECTRICAL PROBLEMS?
THE A. H. S. ELEC. SERV. & ENG. BUREAU, Rendering *Personal Service, will solve them for you through the Mail with Precision.* P. O. No. 132, FLUSHING, NEW YORK

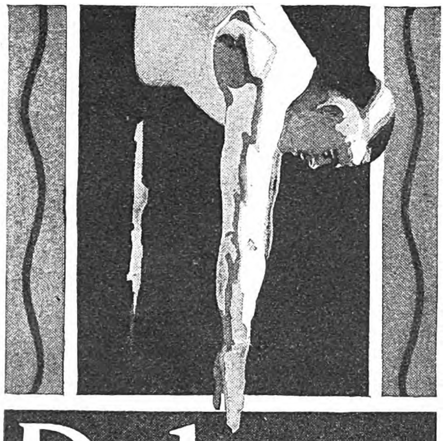
Cruise and live in Comfort

"Matthews 38" SINGLE CABIN CRUISER

Go anywhere in a Matthews Cruiser. Take family and friends. Individual berths, galley, toilet room, mahogany dresser and buffet, wardrobes. Accommodates 6 to 9 persons. Sturdy, seaworthy salt-water construction. 6 cyl., 125 h.p. marine motor; speed 15-17 m.p.h. Write for folder L.

THE MATTHEWS CO., Port Clinton, Ohio, U. S. A.
Quality Service Since 1890

For safety
in Exercise
wear a PAL



Pal ATHLETIC SUPPORTER

© B. & B., 1929

Even in setting-up exercises there is danger to the delicate cords and membranes nature left so vulnerable. A quick movement—a little awkwardness—and suddenly . . . Pain . . . Disablement.

• • •

PAL is far superior to the ordinary all-elastic supporter. It is porous . . . knit of soft-covered elastic threads. A more *efficient* supporter . . . snug where it should be . . . comfortable all over. PAL doesn't get perspiration-stiff . . . doesn't chafe. At all drug stores . . . one dollar. *{Price slightly higher in Canada.}*

Bauer & Black
A Division of the Kendall Co.
CHICAGO . . . NEW YORK . . . TORONTO
Also makers of the famous O-P-C
For 40 years the leading suspensory for daily wear

TEN MILE EYES!

10 POWER
$21.75 Prepaid
"Cheap at $50"
—Says Navy Man
Buy Direct—SAVE HALF

TEN MILE EYES! Think of the things you can see! Ten mile radius—a 20 mile circle — nearly 400 square miles. And you can easily have them. If you can see one mile, these superpower French 10x32mm. stereo-prism binoculars will extend your vision 10 TIMES. ENJOY YOURSELF 10 times more! Multiply pleasures of hobby and sport. Use a pair touring, observation, hunting, golfing, nature study, astronomy, etc. Superbly made for a lifetime of service. Case and straps free.

10 Lenses

4 Prisms

Did you know many ordinary field glasses have but four lenses and most of the better ones only six? But this binocular has 10 LENSES and 4 PRISMS. No wonder it gives an expansive field, brilliant illumination and fine definition.

Extra Power Without Extra Cost

Send $21.75 today for one on FREE TRIAL. Or $1 for one C. O. D., paying postman balance and few cents postage. Check and compare it in every way for five days with others selling for double or more. If you do not like it for any reason whatever your money will be promptly returned. Every glass tested. The U. S. Gov't and State Forestry Dep'ts buy from us. The same in 8x only $18.50. Surpasses others at $23.50 and more.

FREE TRIAL

CATALOG Over 200 Glasses All Makes—$1-$110

Everything in binoculars, field glasses, telescopes and optical instruments. The finest and largest assortment in America. Catalog gives all information how to choose the best for your individual needs at the LOWEST PRICE.

Try America's Leading Binocular House
DuMaurier Co., Dept. 169, Elmira, N.Y.

The Amateur Astronomer

(*Continued from page 259*)

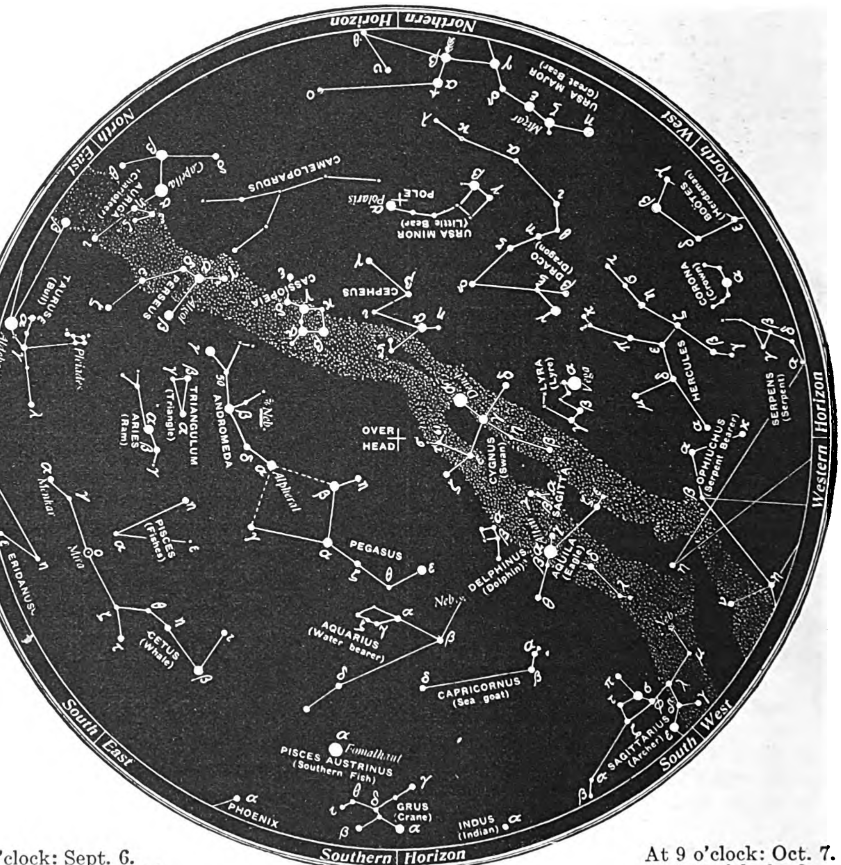
bear directly on mirror making—specifically on mirror figuring—is the matter of resolving power of a telescope, as determined by its ability to separate close double stars. A. R. Dunlop of New Westminster, British Columbia, suggests that all the amateurs send in brief statements of the closest double stars their telescopes will separate—a good idea, especially in view of the fact that one telescope maker, a noted professional, once stated to us that he had seen no amateur mirrors with really good figures. We believe he has not seen a representative lot. How can we convince him there are better ones?

Send in your best examples of double star dividing. For the theory of resolving power see Bell, "The Telescope."

In the July number we broached the question of popularizing seismology, and asked interested readers to write to us. The response was not exactly overwhelming, but we did not expect seismology to make the same killing amateur telescope making did when we broached that subject in November, 1925. A well-known scientist has now sent us, for later publication, the description of a small seismograph of a special type which, to judge from the photographs and drawing, should give the constructor just enough worry to make him feel the job was worth while doing.—*A.G.I., Tel. Ed.*

The Heavens in September

By PROF. HENRY NORRIS RUSSELL, Ph.D.



Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
URSA MAJOR (Great Bear)
Mizar
CAMELOPARDUS
POLE
Polaris
URSA MINOR (Little Bear)
AURIGA (Charioteer)
Capella
TAURUS (Bull)
Aldebaran
Pleiades
PERSEUS
Algol
CASSIOPEIA
CEPHEUS
DRACO (Dragon)
BOÖTES (Herdsman)
CORONA (Crown)
HERCULES
SERPENS (Serpent)
LYRA (Lyre)
Vega
CYGNUS (Swan)
Deneb
OVER HEAD
TRIANGULUM (Triangle)
ARIES (Ram)
ANDROMEDA
Neb.
Alpheratz
Menkar
Mira
PISCES (Fishes)
PEGASUS
ERIDANUS
CETUS (Whale)
AQUARIUS (Water bearer)
DELPHINUS (Dolphin)
SAGITTA
AQUILA (Eagle)
Altair
OPHIUCHUS (Serpent Bearer)
CAPRICORNUS (Sea goat)
SAGITTARIUS (Archer)
PISCES AUSTRINUS (Southern Fish)
Fomalhaut
PHOENIX
GRUS (Crane)
INDUS (Indian)

At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15
At 8 o'clock: Oct. 22

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

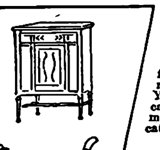
Mercury is an evening star but is not placed for northern observers, since he is south of the sun and therefore sets relatively early. At his greatest elongation on the 12th he sets at 7 P.M. and should be just visible in the twilight. Venus is a morning star in Cancer and Leo, rising between 2:30 and 3:30 A.M. Mars is an evening star low in the west and sets between 7 and 8 P.M. Jupiter is in quadrature east of the sun on the 8th and, being far north, rises at 10:30 P.M. After midnight he is conspicuous. Saturn is in quadrature east of the sun on the 17th and becomes an evening star. Being far south he sets at 10:30 P.M. Uranus is approaching opposition and is observable with the telescope after 10 P.M. Neptune is just past conjunction with the sun and is observable only at the end of the month.

The moon is new at 7 A.M. on the 3rd; in her first quarter at 6 P.M. on the 10th; full at the same hour on the 18th; and in her last quarter at 9 P.M. on the 25th. She is nearest the earth on the 27th, and farthest away on the 12th. She is near Neptune in the sky on the 2nd, Mercury and Mars on the 5th, Saturn on the 11th, Uranus on the 19th, Jupiter on the 24th, and Neptune and Venus together on the 30th.

What is as Important as the Motor?

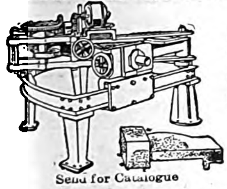
It is the "heart" of every motor-driven device . . . the satisfactory performance of that device depends entirely upon the motor . . . the selection of the proper motor has an all-important bearing upon the service and continued sales of the device . . .
Signal fractional horsepower motors—especially designed for motor-driven devices — induction or series wound . . . have back of them the correct principles of design and embody every essential of a satisfactory small motor . . . designed and built by motor specialists who have been making small motors for manufacturers since 1890 . . . a guaranteed performance that will meet any manufacturer's most exacting needs for motor-driven devices. . . Your particular requirements for small motors can be filled by Signal ... we can design a special motor, if necessary . . . send us your specifications now . . .

SIGNAL ELECTR-C MFG. CO.
Menominee, Michigan
Manufacturers of small motors since 1890



SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe our way, per bend:
1-inch pipe . . . . . . 5 cts
2-inch pipe . . . . . . 10 cts
4-inch pipe . . . . . . 25 cts
6-inch pipe . . . . . . 60 cts
8-inch pipe $1.00
American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.



Send for Catalogue

For fine lines in Color
UNIQUE
TRADE MARK REG'D
THIN LEAD
COLORED PENCILS
$1.00 Per Doz.
1207
24 COLORS
All primary colors and shades

PERFECT for sketching, underscoring, marking plans and blueprints or any work where emphasis is essential.
Leads as thin and strong as in No. 2 black pencils. Easily sharpened in a pencil sharpener.
Per Box
12 colors (asst. 1116) $1.00
24 pencils (asst. 1117) $2.00
At your dealer or write direct
AMERICAN PENCIL CO.
542 Venus Bldg., Hoboken, N. J.
A VENUS Pencil Factory Product

The Scientific American Digest

(*Continued from page 247*)

during which they work, is under 55 horsepower, the corresponding figure for Europe being about 400 horsepower. Any effect of broadcasting on weather would therefore be due to "sub-homeopathic doses" of less than one in a thousand million. Applying the same kind of arithmetic to the suburban home, one finds that to produce a year's rain for the tennis court by means of an electric kettle would cost 800 pounds (nearly 4000 dollars) or more, while the home's contribution to the power bill of the local broadcasting transmitter is an eighth of a penny a year.—*Discovery*, (London.)

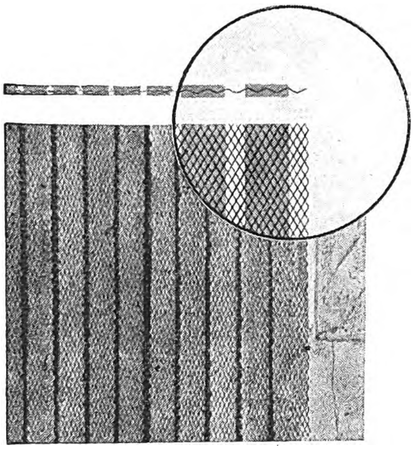
X Ray Detects Smuggled Diamonds

TO locate diamonds swallowed or concealed beneath the skin of those attempting to smuggle them out of the Union of South Africa, government authorities at Port Nolloth are installing an X-ray machine with which suspects can be searched. —*Science Service.*

Fiber-Metal Plaster Laths

THE recent adoption by the Building Trades of the five-day schedule, comes as no surprise to those in the "know."

It is true, perhaps, that relatively few of the mechanics, carpenters, plasterers, riveters, and other laborers appreciate *why* it has been possible to establish a five-day week. But builders, contractors, architects, and engineers have seen this movement coming for a long time past. It is the natural outcome of the never-slackening, onward march of progress, led by science and inventive genius.



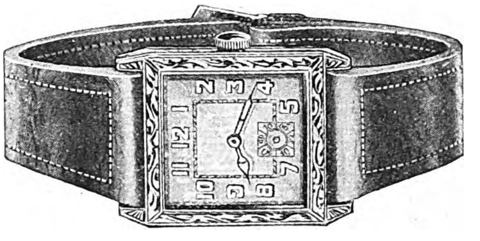
Special fiber is pressed into sheets of expanded metal and the result is a sheet that typifies the common wood lath in form and use

One example of the progress which made possible reduction of working time is the first major improvement in the use of laths—a method dating to extremely ancient times—by the development of a new material to take the place of wood laths. And here again, as has so frequently been the case with other improvements, this one was extremely simple in conception.

In effect, the new lath, while made of fiber, typifies the common wood lath with the addition of a continuous connecting sheet of expanded metal. It might also be described as a rigid framework of expanded steel, impregnated with bands of pressed wood fiber to simulate wood laths.

The new material cuts labor costs, for

SW
Vibration-proof!



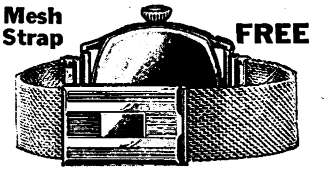
Famous "AVIATOR" Strap Watch

Famous "Aviator" Strap Watch. Modern as the aeroplane. Smart as evening dress. Slender, rugged, trim as a speed boat. Time-true as the stars. At home, in engine-room or ballroom. Hundreds sold to America's leaders of Industry, Sportsmen, Explorers, Aviators and Professional men.

Sold Direct! 10-Days' Trial!

VIBRATION-PROOF Movement designed to withstand thousands of propeller revolutions of Trans-Atlantic flight. Patented 3-piece Case that virtually seals the 15-Jewel Movement from Dirt! Dust! Damage! Radium dial glows time cheerfully in pitch darkness. List price—$36.50! Our "Direct-by-Mail" price for LIMITED TIME only—$29.50! Costly Mesh Strap included FREE to those who order NOW! $29.50!

Mesh Strap FREE



Clever one-piece Mesh Strap that slips on and *off* and *over* and *up* the hand in a "jiffy." No old style prong buckle to fumble with. It protects Watch and adds smart note. GIVEN with each Strap Watch, to make hundreds of new friends! This Gift Offer good only for LIMITED time! Order AT ONCE!

Showing how Watch is slipped up forearm out of harm's way.

Our Plan is Different!
Tens of thousands are buying on this plan:—We ask for NO Money in advance! NOTHING on Delivery! See it! Test it! Wear it! for 10 days
ABSOLUTELY FREE!

If pleased, you may pay on Budget Plan:
$6 MONTHLY
or, if you prefer to pay Cash within 10 DAYS deduct $2.50 and send Check or Money Order for $27. Otherwise return it. Order NOW at this Special Price!
$27

SEAVER-WILLIAMS CO.
Importers, Exporters, International Mail-Order House
365 WASHINGTON STREET, BOSTON, MASS.
Sole Distributors of "Aviator"
Gentlemen:—Please send $29.50 "Aviator" Strap Watch with FREE Mesh Strap for 10 Days' Trial on your "No money in Advance—No money on Delivery" Plan.
NAME
ADDRESS
CITY STATE
Clip and mail this Coupon NOW! If a new customer please tell us something about yourself. We will appreciate and respect the information. THANK YOU.
Sci. Am. 9-29

Why PURE CHEMICALS CORRECT ALL FEED WATER TROUBLE!
They prevent precipitation, control concentration, stop and prevent corrosion and pitting, remove oil or grease (carbonized or not), act uniformly under all temperatures and pressures, everything that is required to successfully treat boiler feed water. Only Pure *Corrective Chemicals* do this. *Pamphlet on Request*
UNISOL MANUFACTURING CO.
Jersey City, N. J., U. S. A.
Orders for UNISOL may also be purchased through HENRY W. PEABODY & CO., Export & Import Merchants, 17 State Street, New York City, N. Y., and their branch offices in Boston, San Francisco, London, Liverpool, Manila, Shanghai, Sydney, Melbourne, Auckland, Cape Town, Johannesburg, Durban, Buenos Aires.
Sime, Darby & Co., Limited, Singapore, S. S. Agents for Straits Settlements

WANTED MEN
To Manufacture Metal Toys and Novelties

Big demand for Toy Soldiers, Animals, 5 and 10c Store Novelties, Ashtrays, etc. We co-operate in selling goods you make also buy them from you. Small investment needed to start and we help you build up. WE FURNISH COMPLETE OUTFITS and start you in well paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life time for man with small capital. CHRISTMAS RUSH is now starting, so if you mean strictly business write AT ONCE for full information.
METAL CAST PRODUCTS COMPANY
Dept. S 1696 Boston Road New York City

SPARE TIME TRAINING that leads to BIGGER PAY

Do you want a better position and a higher salary? You can have these if you can do the work. LaSalle experts will show you how, guide you step by step to success and help solve your personal business problems through the time-saving LaSalle Problem Method. Our *salary-increasing plan* enables you to prepare during your spare hours, without interference with your present duties. Simply mark on the coupon the field in which you desire success, and we will mail you a valuable book describing the opportunities in that field, together with an outline of our *salary-increasing plan.* Also copy of "Ten Years' Promotion in One." There is no cost or obligation. Find out how the *salary-increasing plan* starts average men and women on the high road to success and financial independence. Check and mail the coupon NOW.

— — —*Find Yourself Through LaSalle*— — —

LA SALLE EXTENSION UNIVERSITY
The World's Largest Business Training Institution
Dept. 951-R Chicago

Tell me about your *salary-increasing plan* for my advancement in the business field checked. Send also copy of "Ten Years' Promotion in One," all without obligation.

☐ Business Management
☐ Modern Salesmanship
☐ Higher Accountancy
☐ Traffic Management
☐ Railway Station Mgmt
☐ Railway Accounting
☐ Law—Degree of LL.B.
☐ Commercial Law
☐ Industrial Management
☐ Banking and Finance
☐ Modern Business Correspondence
☐ Modern Foremanship
☐ Personnel Management
☐ Expert Bookkeeping
☐ Business English
☐ Commercial Spanish
☐ Effective Speaking
☐ C. P. A. Coaching
☐ Stenotypy
☐ Telegraphy
☐ Credit and Collection Correspondence

Name................................

Present Position................................

Address................................

PRATT INSTITUTE
BROOKLYN, N. Y.
School of Science and Technology
Industrial Mechanical Engineering
Industrial Electrical Engineering
Industrial Chemical Engineering
Intensive TWO-YEAR Courses
Send for Circular of Information

BE A MEAT CUTTER
Harry Holtzer stepped into $50 a week job as Meat Cutter through NATIONAL training. You, too, can do the same. Previous experience not necessary. We teach you through our Home-Instruction Course. Don't get by—get ahead. Write today; FREE book, "Big Pay the NATIONAL Way."
NATIONAL SCHOOL OF MEAT CUTTING, INC.
Dept. F. Toledo, Ohio

POSITION WANTED
Chemical and Production Executive
process industry, 46, wants position.
State proposal complete.
M. C. Dearing, P. O. Box 172, Ontario, California

Electricity!
Learn in Los Angeles

Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00 — unlimited opportunities now.

Practical, intensive training by National's job-experience method in 6 to 9 months. All technical essentials included. School endorsed by leaders in electrical industry. You learn all branches of electricity; radio. Million dollar institution; all modern equipment and training facilities. Life scholarship. No age limit. Free employment service. Over 17,000 successful graduates. 23rd year. Big, illustrated 84-page catalog sent FREE. Write today. FREE BOOK

NATIONAL ELECTRICAL SCHOOL
Dept. 301-EC 4006 So. Figueroa, Los Angeles. Calif.

every time a "section" is put up it is equivalent to the setting of 30 eight-foot laths. To this advantage may be added the features of fire-resistance, sound-deadening, and positive checking of rats and vermin. Exhaustive tests have shown the new material practically eliminates cracking because it cannot shrink, swell, nor warp like wood. The fine steel meshes, while giving a perfect bond, permit less plaster to be used. This means plaster economy.

More About the Robot

HAVING read the item in this department in our July 1929 issue concerning the robot, Mr. Wolf A. Lederer has very kindly submitted further information relative to the derivation of the word robot. A portion of his letter follows:

"In the province of Bosnia and The Hercegovina, the section of Jugo-Slavia I hail from, this word had another meaning too. For there it meant, if used as a verb: to robot, heavy physical labor which is not being paid—that is, there existed the old feudal system until 1918 and the 'knez,' (equivalent to the medieval serf) was required to do a certain amount of free labor for his master, the 'aga' or 'pasha.' This work frequently consisted in building roads and, in some sections, the men and women of several villages were required, each village furnishing a stated number, to perform this work, which was *not* paid for. These people were called the 'robotasi' (robotashy) and had to perform this labor so many days every year, or month, depending on the agreements. It was finally also extended to convict labor; also heavy labor without pay. The origin is from 'rob' meaning the slave."

Console Plays Symphonies in Light

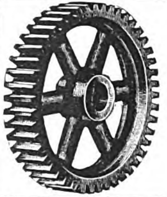
WITH a recently developed apparatus which looks like a minature pipe organ console, symphonies of light without a single repetition of scene may be "played" for hours at a time. Then when the operator tires of composing light harmonies, a touch of a button starts a pre-arranged cycle of chromatic rhythms; an automatic roll similar to the player piano roll takes over the job and the operator is free to watch the machine bathe the setting in rainbows of ever-changing colors. The apparatus may be used in show windows, in ballrooms, in theaters, and as a dazzling fountain or a stately memorial.

This apparatus, which is called the Lumitone and is manufactured by Curtis Lighting, Inc., of Chicago, is a control device for mobile lighting which provides for the automatic or manual remote control of all circuits. The dimming of lighting circuits is accomplished without flicker and in exactly the order which has been pre-determined. When the automatic playing roll is used, various color effects can be planned and executed with certainty for several hours without repeating a single setting. Each dimmer is driven independently of any of the others and can be moved up or down, or the circuit can be turned on and off regardless of the condition or movement of other dimmers.

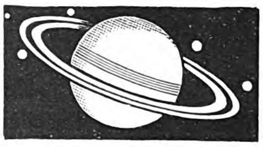
In the tracker bar over which the record roll passes there are four holes for each circuit. One of these turns on the current, one moves the dimmer up, one moves the dimmer down, and one turns the current off. As the paper roll passes these openings

ASBESTOS
All grades of Crudes and Fibres in large or small quantities
Sold by
KEASBEY & MATTISON COMPANY
Ambler, - Penna.
Branches in Principal Cities

Bond STANDARD STOCK GEARS
Stocked for immediate shipment in large industrial centers
Send for Catalog 54-S
CHARLES Bond COMPANY
617 Arch St., Phila., Pa.



GEARS
All Kinds—Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago



ASTRONOMICAL TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.

Inventions AND Patents
By Milton Wright
Sound practical advice to Inventors, covering the entire field from the inception of the idea through to the legal forms of assignment, sale or royalty, with numerous hints suggested by the experience of many years practice.
($2.65 postpaid) DOMESTIC
SCIENTIFIC AMERICAN
24 West 40th Street
New York, N. Y.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
Labor Saving Machinery Designed & Built
Circular - References - Guarantee - Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

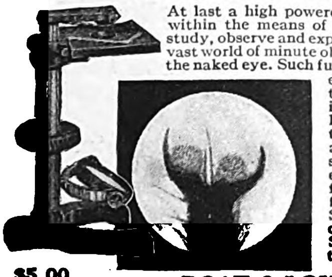
Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

PATENT FOR SALE
THE MOST WONDERFUL ONE QUARTER TURN HOSE CONNECTION for Air, Steam, Gas, Oil, Sand and Water, ever shown to the public. Price $5,000. Patent No. 1,591,871.
J. J. HEINRICH, 2135 South Michigan Avenue, Chicago, Ill.

BECOME A FOOT CORRECTIONIST
$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
STEEL LETTERS AND FIGURES
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

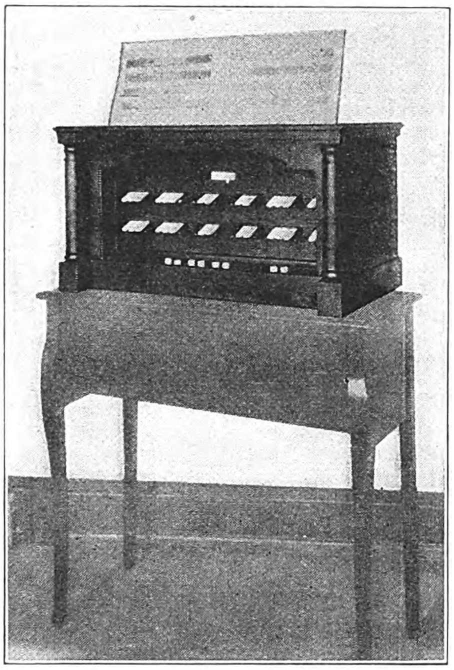
Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE



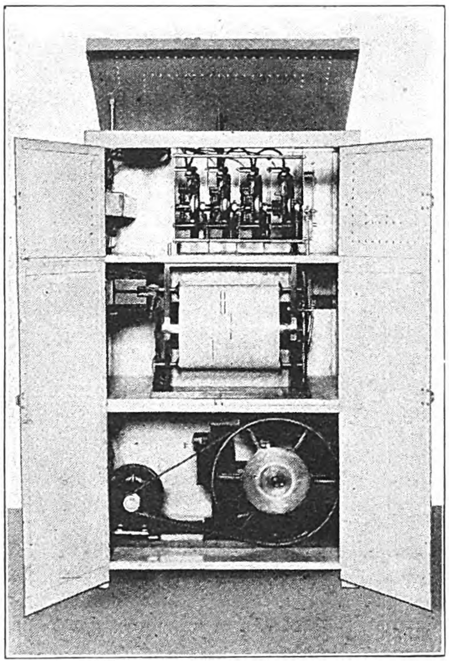
At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.
$5.00 for Complete Outfit Prepaid
ROAT & LOHMAN
Dept. 102 Milton, Pa.

the functions of each are performed according to the pattern of the perforations. The entire mechanism functions through the use of electro-pneumatics.

The manual keyboard is divided into three main divisions: solo, accompaniment, and special effects. The solo section plays all of the colors which are directed toward the main feature of the display. The accompaniment section plays all the colors in the background. The background may be kept subdued as in a great solo, or may be brought up in a crashing crescendo as in a large chorus effect. The special effect buttons are imbedded in the shelf and are used only when something out of the ordinary is to be executed. The solo keys are in the upper bank and are usually played with the right hand while the accompaniment keys are in the lower bank and are usually played with the left hand.



Above is shown the console by means of which veritable symphonies in light may be "played." Below is the interior mechanism of the apparatus showing the "music roll" control for the lights



CLIP AND MAIL THIS COUPON
HAMLEY 95 Court Street, Pendleton, Oregon
☐ Send, postpaid, the following order of Hamley Kits:
........Medium *(8⅝ x 3⅞ x 1⅞) @ $ 6.00 $..................
........Large *(9½ x 4½ x 2¼) @ $ 7.50 $..................
........Extra Large *(10½ x 5⅜ x 2¾) @ $10.00 $..................
Name or initials embossed on lid, 25 cents extra.
Total check enclosed $..................
☐ Send literature with full size illustration.
Send to..................
Address..................
*Inside measurements

New Idea in Toilet Kits
Genuine Solid Leather

HERE'S the handiest, best-looking toilet case you ever saw. A simple solid-leather box, *minus* the tricky loops and gadgets and cubby holes which waste time and patience. You just toss toilet articles in. No packing at all... everything *fits*. Made of choice, thick solid leather in natural russet color, which takes on a rich dark glow with the passing years. Sewed with heavy waxed saddle thread, with corners backstitched by hand and guaranteed not to rip. Sent postpaid. If you do not like it, we cheerfully refund your money! Hamley & Company, Saddle Makers, 95 Court Street, Pendleton, Oregon, U. S. A.

The HAMLEY KIT
If your dealer cannot supply you, order direct

TRY OUR
BOOK SERVICE
SCIENTIFIC AMERICAN

SCIENCE NEWS-LETTER
RUSHES NEWS

EACH day Science News-Letter gathers by radio, telegraph and fast mail the current happenings in *every branch of Science.* These facts are rushed to us by trained scientific correspondents located throughout the world. Here they are written up in short, non-technical story form in a way to *entertain the general reader.* In the rewrite they lose nothing of their high scientific value. Human interest is simply injected with the result that Science News-Letter is a delightfully readable weekly, brimming over with all that is recent, important and unique in scientific news.

Introductory Offer, $1 for 13 weeks
Science Service
2165 B St., Washington, D. C.

Our Choice of Recent Books

Brief Course in Chemistry

By L. C. Newell, Prof. Chem. Boston Univ.

THIS very much condensed text represents the minimum course as selected by a Committee of the American Chemical Society. It is divided into two parts, minimum essentials and supplementary topics, both of which cover more particularly the applications to industry. As a reference for the occasional question, this book will give the fundamental points within the most circumscribed space. $1.65 postpaid.

Blueprint Reading

By Dalzell-McKinney-Ritow

SOME time in the ordinary course of business or home life we all have occasion to seek information from blueprints or drawings. Without some knowledge of the general points involved, the intricacies of details, figures, and lettering are most confusing. This book explains clearly and concisely just what it is all about so that the average layman without knowledge of drafting will be able to get the fundamental facts from construction drawings. $1.40 postpaid.

Sun Rays and Health

By Ronald Millar and E. E. Free

SO far as we know this is the first really popular book on the ultra-violet rays in connection with health. It could be understood by almost anyone. People who do not wish to study the intricacies of the physics of the subject but are willing to accept an end-product which is thoroughly accurate and scientifically trustworthy, will find this little book "just the thing." $1.65 postpaid.

Men and Machines

By Stuart Chase

A WELL considered discussion of the indisputable hold which machines, in the broadest sense, have upon every passing minute of our lives. What we would be reduced to, were we suddenly bereft of such help, and how in the end the balance seems to be automatically adjusting itself so that social advance is keeping step with mechanical improvement, the whole weaving a fabric of more happy and contented lives for the great majority, with freedom from the condition described by the old adage of servitude of labor. Deeply thought out, splendidly written, and most engaging in style. A book worth careful consideration. $2.65 postpaid.

Peaks of Invention

By Joseph Leeming

AN appreciation of the most important inventions of the last 25 years, and an analysis of the many years of preparation which were necessary to assure wide practical usage. A book of enjoyment for those who have not lost their sense of wonder at our amazing development. $2.65 postpaid.

Lindbergh
His Story in Pictures

By D. T. Miller

ONE would be atrophied indeed did he not thrill again to the stimulation experienced by the world on the occasion of the first transatlantic flight, while he passes from page to page of this most unusual book of photographs, the legends of which alone tell the story of a wonderful achievement. Absorbing as was Lindbergh's book "We," an even more intimate record is here given, for the study of facial expression, crowds, and high personalities is far more interesting than the printed text. No event has ever demonstrated the efficiency of photographic news as does this most extensive and unique collection. $2.65 postpaid.

A Guide to Bernard Shaw

By E. Wagenknecht

THE purpose of this book is to include within narrow convenient compass, all pertinent information needed to read Shaw's works intelligently. All his work being based on a definite theory of art and life, it is essential for the general student to know just what this viewpoint is. Written with admirable clarity and literary good sense. $1.65 postpaid.

Aspects of Biography

By Andre Maurois

ONE of the foremost of present day biographers analyzes the various component parts of this almost uncharted subject and suggests many admirable objective standards, which are badly needed, by which adequate judgment can be made; indeed these standards may well be applied to the writing. All presented with extreme lucidity and in a most engaging and readable style. $2.15 postpaid.

All Quiet on the Western Front

By Erich Maira Remarque

OF French stock which emigrated to the Rhineland during the Revolution, at the age of 18 the author entered the German army and experienced every vicissitude. The viewpoint illustrates the deep unrest that men of his generation experienced. A subsequent career of successful activity never fully seemed to mitigate the war's consequences, yet the story never reaches a point of sodden bitterness. Quite one of the best books on the subject that has appeared. $2.65 postpaid.

War

By Ludwig Renn

HERE is an account of the personal experiences of a German N. C. O. in which the march of men and events is set forth with candor and clarity. It is a genuine "front" book, said by the German press to be the best written from this angle of approach. $2.65 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Rear Admiral Awarded Damages in Torpedo Plane Patent Suit

DAMAGES amounting to 198,500 dollars for infringing the patent rights of Rear Admiral Bradley A. Fiske, retired, have been ordered in a judgment rendered against Rear Admiral William A. Moffett by the Supreme Court of the District of Columbia. It was understood by the court that Rear Admiral Moffett had authorized and ordered the manufacture and use of 397 torpedo planes, valued at 500 dollars each, infringing the patent rights of Rear Admiral Fiske who invented the torpedo plane in 1912.

The question was raised as to whether the government and its officials possess the right to use without compensation the patented inventions of individuals employed by the government. Justice Stafford, of the Supreme Court of the District of Columbia, held that, "the right of an officer in the Navy or the Army to take out a patent has been recognized by the Supreme Court of the United States, and is no longer open to question."

It may seem both improper and unfair for Rear Admiral Moffett, as an individual, to be the defendant in the case, but the court ruled that validity and infringement having been established, the plaintiff as owner of the patent had the right of action for damages.

"This right of action he had against the defendant as a wrongdoer, personally and individually, notwithstanding the fact that his acts of infringement were performed by him merely as an official of the United States and without profit to himself," in the opinion of Justice Stafford. Rear Admiral Moffett has appealed the judgment to the Court of Appeals of the District of Columbia.

Sleeve Valve Motor Held Different From Prior Patent

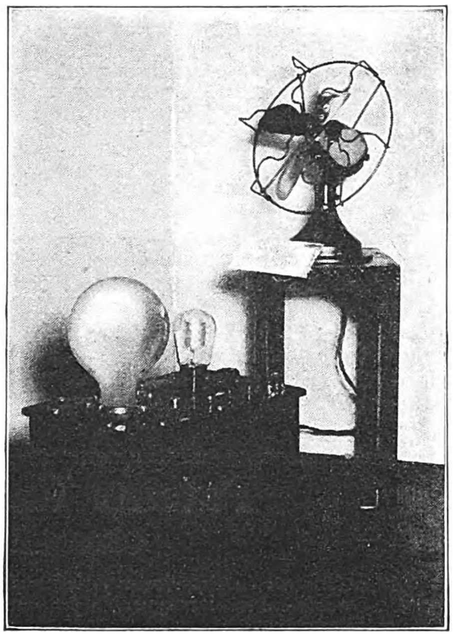
NO suggestion of a sleeve valve formed of reticulated steel was found in the prior patent for a reciprocating sleeve valve taken in connection with a car axle journal bearing made preferably of reticulated metal parts. This decision resulted in the grant of Patent 1718082 to Charles Schaeffer for an improved sleeve that slides against the cylinder wall of an internal combustion engine.

The Schaeffer valve is constructed of reticulated steel, and is coated both inside and outside with interconnected antifriction metal such as copper. According to the inventor, this construction gives greater strength than the sleeve valves of the usual type. Due to its design, the sleeve fits closer to the cylinder without gripping, reducing the oil consumption as well as assuring longer service before the valve wears out.

The application had been rejected by the Examiner, who was of the opinion that the Schaeffer sleeve valve was simply a combination without invention, utilizing the reciprocating sleeve valve shown by Miller, with the use of reticulated metal sheets as used by Sargent in a car axle journal bearing. The Examiner's rejection was reversed by the decision of the Board of Appeals.

Makers of "Just-as-Good" Parts for Automobiles Lose in Suit

AN order has been issued by the Circuit Court of Appeals for the Seventh District to restrain certain manufacturers of automobile hub caps from making and selling parts in unqualified imitation of those provided on Buick, Oakland, Chevrolet, and Pontiac cars. The decision was in favor of the General Motors Corporation, confirming the holding of a lower court that the owner of the trademark in question is exclusively entitled to market all replacement parts bearing that trademark. Of course that would not hinder anyone from making and selling articles like the original in size and shape, but the public has a right to know that replacement parts bearing the trademark of a well-known manufacturer are "genuine" and not merely "just-as-good."



Courtesy Museum of the Peaceful Arts

When one's hand is moved near the metal ball, electric circuits close, starting the fan, thus demonstrating the remarkable sensitivity of the "grid-glow" relay, shown on top of the cabinet next to the ball

Addition of Useless Step Irrelevant to Infringement

IN a recent suit for infringement of patent rights, the defendant contended that the adoption of an additional step in the process should defeat the charge of infringement. The case was an action in equity in the District Court for the Eastern District of New York, for an injunction to restrain the Greenport Sewerage Company from working a process for antisepticizing water and sewage, covered by a patent issued to Georg Ornstein and assigned to the Electro Bleaching Gas Company.

After the validity of the Ornstein patent had been confirmed, the court found that the added step used by the Greenport Sewerage Company was of no value to the process, according to the testimony of experts. A decree was issued in favor of the plaintiff, granting the injunction.

Who Does The Inventing?

TRACING the progress of civilization from the day when man, presumably, dropped from a tree with a fragment of his former home for a weapon with which to face the beasts of the jungle, William M. Grosvenor, in an article which recently appeared in *Chemical Markets*, discusses some rather significant points regarding the urge to invent and its result.

"Invention has gradually converted communicative grunts and growls into the power and melody of speech and song," Dr. Grosvenor believes. "Invention developed the notches on a stick and the scratches on tablets of baked clay into literature and libraries. Invention has turned the shelter of the hollow tree and the cave into the palatial home and the skyscraper. It has given us not only our languages, our weapons, and our houses, but also our transport on land, sea, and air; our money, banking, and exchange; our rapid communication by light, wire, and wireless; our thoughts, our cultures, and even our religions!" From the nature of this eulogy, one might suppose that Invention had died and was being buried.

But Dr. Grosvenor has another purpose. He points out that the progress of civilization was very slow until man added the word "reward" to the old blurb about "supply and demand." When the realization appeared that a demand and reward created a supply, "inventions became for the first time consciously the garnered and nurtured seeds of progress."

This leads to the astute observation that "the patent system, itself, is an invention for fostering invention." But the heart of the article by Dr. Grosvenor is contained in his comparison between the product of the pioneer inventor, working "on his own," and the inventions developed by research in the laboratories and shops of our large industrial corporations.

"Thirty years of observation and research in patent matters convince me that the proportion of *revolutionary* improvements, which is initiated by large corporations is relatively small. I have seen the lines of progress that were most promising for the public benefit, wholly neglected or positively forbidden just because they might revolutionize the industry. We have no right to expect a corporation to cut its own throat from purely eleemosynary motives." (By the way, that word means *charitable*—Editor.) Dr. Grosvenor gives due credit to the big corporations for what he calls "development research" and improvements in organization, economies, enlargement, advertising, and merchandising. But when it comes to pioneering, he says, the story is very different.

"From Noah's Ark down the ages to Marconi and the Wrights, it has generally been the so-called 'crazy' fellow, who didn't know any better and was working on his own, who revolutionized affairs and opened up new horizons of progress by creating new industries and rendering old industries more or less obsolete. He had his own vision, made his own sacrifices to his own gods, and there was no man to say him nay; so he kept on trying until it happened. Railroads were absurd, steamboats were unsafe, explosives dangerous to use, wireless was a scientific curiosity, heavier-than-air machines were demonstratably impossible. Gasified motor fuel was a waste of volumetric efficiency, many a Bergius process was either not theoretically practicable or not practically worth while, et cetera. Had the authorities of the time had their own way, we would have had no Judaism, no Christianity, no United States of America. Freedom of individual initiative and security of desired recognition and reward if successful, are what both common sense and history teach us to be the essentials to big strides of progress."

A tabulation of the revolutionary inventions made since 1889, when large corporate investigation may be said to have started, shows that 12 out of the 72 outstanding inventions have been produced by corporation research. Of these inventions, a few that are typical are: high-speed steel, vat dies, ductile tungsten, oil cracking, Permalloy, and silica gel.

During the same period, independent inventors working "on their own," contributed such inventions as: monotype, case hardened steel, photogravure, motion-picture camera, dial telephone, calcium carbide, Deisel engine, carborundum, motion-picture projector, radio telegraph, electric train-control, electric automobile starter, submarine, safety razor, airplane, flotation process, radio crystal detector, Bakelite, electric precipitation, gyro-compass, and salvarsan.

Although not pointed out in Dr. Grosvenor's article, it is rather significant that inventions produced as a result of research fostered by large corporations are becoming a more important factor every year. For example, not more than seven out of 55 inventions of outstanding importance patented from 1890 to 1910 were the result of corporation research; but during the next twenty years, roughly, there were five out of 17 major inventions credited to corporation research. Apparently our large industrial organizations are profiting by history's great lesson, "He who does not advance falls behind."

Makers of "Castoria" Win Trademark Decision

"BABIES Cry For Castoria," according to the nationally-known advertisements of the Centaur Company. It isn't on record that old men cry for it, but many of them recall the name and what it signifies. Of course the patent for "Castoria" has expired, but the trademark continues to be a commonly known word with a definite meaning. Consequently the deliberate misuse of the word, to designate an entirely different preparation, is unfair to the maker of "Castoria," and confusing to the public. Wouldn't it confuse and discourage a baby, if he cried for "Castoria" and got shoe blacking or shaving soap?

"A plainer case of intentional and wrongful invasion of the plaintiff's rights could hardly be concieved," said the District Court for the Western District of Pennsylvania when the Centaur Company brought suit for infringement and unfair competition against E. Genish, et al. The defendant was accused of selling as "Castoria" a preparation of an entirely different nature than the "genuine" product.

It had been held previously, in the case of Centaur versus Heinsfurter, that the expiration of the patent to Samuel Pitcher dedicated the name "Castoria" to the public, the assumption being that the product sold under that name was the product of the Pitcher patent. Based on that assumption, it had been held that the name was public property, if two or more manufacturers were making and selling the product of the expired patent.

But the record in the present case shows conclusively that "Castoria" as manufactured by the plaintiff for over 50 years is not, and never was, the product of the expired Pitcher patent. A comparison of the three formulas shows that the defendant in the case against E. Genish was unquestionably selling something different from the product of the Pitcher patent and different from the well-known "Castoria" of the Centaur Company.

The court ruled that the dedication of the trademark to the public, with the expiration of the Pitcher patent, was not proved. The word "Castoria" was judged subject to exclusive appropriation as a trademark, being an arbitrary term used to designate origin. A decree was granted, restraining the defendant from further infringement and unfair competition.

"Doctor B. F. Davis" Wins Approval as Trademark

BECAUSE the words were arranged in a distinctive manner, the notation, "Doctor B. F. Davis," has been allowed registration as a trademark. The word "Doctor" is placed above the name "B. F. Davis," the largest letters being in the center, the other letters tapering toward each end, and the general outline being completed by the use of triangular dots at each end.

The examiner had refused registration on the ground that the notation, being but the name of an individual, cannot be registered as a trademark because not written, printed, impressed, or woven in some particular and distinctive manner. First Assistant Commissioner Kinnan ruled that the examiner was in error, and that the entire notation was set forth in an unusual way, and that it is proper to consider it printed in a particular or distinctive manner.

Inter-Industry Distribution

THE high cost of many commodities is attributable in no small measure to the high cost of distributing them. It has been estimated that the wastes in the distribution of goods to the consumer amount to eight billion dollars a year and ways and means to cut down that waste have been studied long and earnestly.

Not all the waste, however, is to be found between the manufacturer and the consumer. There are undoubtedly leaks between the producer of the raw material and the manufacturer, and this is a phase of industrial merchandising which apparently never has been studied. Realizing this, the Department of Commerce has rec-

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

COLLAPSIBLE GAS CONTAINER WITH INTERNAL BRACING—For airships of the lighter than air type, so constructed that the container may be quickly and easily inflated with a gas free from air, and will permit the container to be entirely collapsed when empty. Patent 1715829. Otto Geisler.

Chemical Processes

PROCESS OF MANUFACTURING YEAST—Which comprises chilling a yeast propagating wort, having a slight alkaline reaction, by forcing the cold gases and vapors from expanding liquefied carbon dioxide through said yeast wort until it shows a slight acid reaction. Patent 1718910. Lucien Lavedan.

Designs

DESIGN FOR TEXTILE FABRIC—The inventor has been granted three patents for ornamental designs, 78633, 78634, 78635. Joseph Kullmann.

DESIGN FOR A BABY CARRIAGE BODY—Patent 78630. Florence M. and William Karle.

DESIGN FOR A STOCKING—Patent 78639. Ruby Lefi.

DESIGN FOR A CATALOG COVER—Patent 78679. Marshall E. Yadon.

DESIGN FOR A TEXTILE FABRIC—Patent 78623. Dezso R. Grulich.

DESIGN FOR A DRESS—The inventor has been granted four patents for dress designs, 78767, 77768, 78769, and 78770. Dorothy Long.

DESIGN FOR A DISH OR SIMILAR ARTICLE—Patent 78746. William P. Graham.

DESIGN FOR A GLOVE OR THE LIKE—The inventor has been granted two patents for ornamental designs, 78836 and 78837. Wallace E. Meyer.

Electrical Devices

ELECTRIC WATER HEATER—A small compact unit which may be conveniently attached to any pipe line or faucet, and will serve to heat ommended to Congress for 1930 a National Distribution Census. To ascertain the possibility of obtaining the data called for in that recommendation, the Department recently began a census of industrial purchases in Cleveland, that city being selected because of the diversity of its industries and the complete co-operation offered by the manufacturers and the Chamber of Commerce.

The data requested includes an itemization by value of the purchases of manufacturers, for the year 1927. The items are to be classified by their use into four groups: (1) Raw materials (products which have not passed through a process of manufacture); (2) semi-finished goods (materials other than raw materials purchased for further processing, or fabrication into the products manufactured by the institution being enumerated); (3) mill supplies (materials used in the general maintenance of the plant, exclusive of material used in the repairs to machinery and the conditioning of plant equipment); and (4) plant equipment (including repair and maintenance supplies for conditioning plant equipment).

Gorton James, Chief of the Division of Domestic Commerce, sums up the situation in a statement as follows: "The marked progress in recent years in the production of commodities has been based largely on information developed by research, trade associations, and the state and federal government agencies devoted to promoting the welfare of American industry and commerce. This information has revealed opportunities for eliminating waste of former trial and error methods, and has resulted in increased efficiency and lower business costs.

"We now have problems of distribution which, in a like manner, require adequate factual information to furnish a basis for attacking these problems more intelligently. The buyer is suffering from disproportionate sales expense which is reflected in increased cost of products. The seller has thought it necessary to work many markets that, if the facts were known, probably would not support half the outlay assigned to them."

Fish Balls and Fish Cakes

ARE fish balls animal food or vegetable food?

There is room for a difference of opinion there. The question is an important one, for upon the proper classification of the article depends the amount of duty an importer has to pay. Collectors of customs at different ports have been making their own individual interpretations and considerable discord has resulted. The Commissioner of Customs, E. W. Camp, has been trying to straighten it out.

Confusion arises, he finds, from articles which originally were vegetables but which have lost their identity as vegetables. Bean flour, pea flour, yam flour and soya bean flour were comparatively easy to solve; they are prepared vegetables. Now, however, we have a more complex article—a product not made directly from vegetables, but from vegetable products.

A close study of the law leads to a solution. In paragraph 769, potato flour is specifically provided for. Fish balls contain potato flour. Fish balls, therefore, from now on in every port of entry in the country shall pay the duty provided for potato flour—20 percent *ad valorem*.

The decision would seem to be in line with the ones classifying salted watermelon seeds as nuts or a barrel of live snails as wild animals. You can't stump a customs collector.

water flowing therefrom, the water itself acting as a conductor and resistant for the current which heats it. Patent 1717308. Vincenzo Boschetti.

Electric-Light Fixture—Having a front reflector to hide lamps, and to throw rays of light on rear reflectors laterally and indirectly forwardly, and intermediate reflectors converging outwardly, and lamps at the outer sides behind the front reflectors, diffusing the light rays upwardly and downwardly. The inventor has been granted two patents on ornamental fixtures. Patents 1718154 and 1718155. William Klehr.

Of Interest to Farmers

Grain Ventilator—A combined ventilator and drier, consisting of an elongated tubular member containing a body of moisture absorbing material, and central and lateral air passages which may be imbedded in a storage bin to prevent grain from molding, etc. Patent 1715256. John Stroble.

Milking Machine—Having a pulsator with automatic means for relieving the vacuum and admitting air under atmospheric pressure to the cow's udder, thereby simulating calf milking, the pulsator movements being noiseless in operation do not disturb nervous cows. Patent 1715720. Warren A. Shippert.

Power Lift for Tractor Plows—An arrangement which utilizes part of the power of the tractor engine in lifting a plow carried and driven by the tractor from operative or working position to an inoperative or suspended position upon the tractor frame. Patent 1717209. Levi C. Hester.

Irrigation Furrow-Forming Device—For cutting one or more trenches in a field or orchard for conveying irrigating water, having means for facilitating the adjustment of the cutting tools vertically to provide for a furrow of required depth. Patent 1716704. Thomas Mansfield.

Of General Interest

Fastening Device—A button-type fastener having a recess therein for receiving a fold of securing fabric, and a pin-type fastening element extending through the fabric in the recess to form a fastening means. Patent 1715258. Othar S. Tonn.

Process of Aging Calcined Gypsum—Which comprises the direct application of moisture, in a fine spray form, at the rate of from twelve to fifteen pounds to the ton of calcined gypsum per minute, for five to six minutes, while agitating the gypsum. Patent 1713879. Samuel G. McAnally.

Safety Deposit Receptacle—A box one side of which is provided with means whereby the receptacle may be securely attached to a wall bracket as used in railway cars, so that a traveler may safely protect his valuables. Patent 1714236. Edward S. Peer.

Adjustable Stand—For rivet cutters and the like, having a plurality of cutter rests and means pivotally connected with one of said rests for adjusting it vertically to vary the cutting angle of the tool. Patent 1715260. Peter Weber.

Comb—Having longitudinal passages through which a cord may be run, adapted for the drying the hair by absorbing moisture when the hair is combed, and also for applying oil or a tonic to the hair. Patent 17310 (Reissue) Harry H. Hutchings.

Bookstand—In which a number of binders are mounted to conveniently hold books such as telephone directories and the like, and enable any book to be moved to reading position without detaching the book from the binder. Patent 1715233. Walter E. Haskin.

Patent Examiner Hutchinson Completes 62nd Year in Service

WINNING the commendation of Secretary of Commerce Robert P. Lamont, as well as the cordial congratulations of his colleagues, Mr. William T. Hutchinson recently completed his sixty-second year in the employ of the United States Patent Office in Washington. Secretary Lamont's letter said:

"My dear Mr. Hutchinson: The Commissioner of Patents has just informed me that you are today completing your sixty-second year in the Government service and that you have charge of the applications for patents on such important inventions as time-locks for bank vaults, combination locks, et cetera.

"This is indeed a remarkable service, and I wish to felicitate you upon your long career of work well done. The Commissioner of Patents assures me that your knowledge of the complicated inventions under your charge and the manner in which you perform your work are particularly worthy of commendation."

Coming shortly after the Patent Office had been criticised as "a kindergarten for patent attorneys," this evidence of long service is of particular interest. It has been suggested that in too many cases young men become patent examiners, learn the intricate details of Patent Office procedure, and then when they become competent to serve in their new capacities, resign to take more lucrative positions with law firms.

In an editorial comment which appeared recently in *Industrial and Engineering Chemistry*, a startling but rather interesting remedy for such a situation was suggested. The contributor was directing his suggestion toward the chemical industry, but it may interest those in other industries.

"Don't think I'm criticizing the Patent Office. I don't blame the youngster who quits in order to better himself financially, nor the new examiner who is conscientiously trying to do a highly technical job with which he is not yet familiar.

"I'm only cursing our governmental system that saves a hundred dollars in patent examiners' salaries at a cost of thousands of dollars to industry in general, and I'm proposing in good faith that we, who have to pay the fees of patent attorneys, endow the Patent Office—we can well afford to—so that examiners will be paid enough to make the office something more than a training school for ambitious young men."

The suggestion that industry "endow the Patent Office" is not so radical as one might suppose, although there is little possibility that the United States Government would openly admit its incompetence to deal with any problem so vital to industrial and individual prosperity. Several of the other Bureaus of the Department of Commerce are practically "endowed" by specialized industries, and it may be that within a few years patent cases will be tried by technically trained judges, in a special patent court. But we do not anticipate any serious attempt to endow the Patent Office.

Elevator Saddle—Or sill, for the guidance of elevator doors, comprising a plurality of interlocking longitudinal sections with any desired number of grooves, always coupled by an arrangement of flanges. Patent 1715188. John Bullock and Lauritz U. Lacour.

Device for Forming Braidlike Decorations—With means for receiving a plastic substance, such as sugar paste, plaster or the like, whereby a twirling motion is imparted as the substance is forced out, thus presenting a braidlike form. Patent 1714234. John A. Ost.

Ornamental Building—A structure of conical form, having doors and windows near its base, and depicting an edible ice cream cone, with means for illuminating the exterior by projected lights to harmonize with the cone and colors of the ice cream. Patent 1713050. George H. Natzel and Frank E. Jackson.

Spring Action for Firearm Hammers—Capable of application to all types of firearms, when applied to automatic pistols, dispenses with the comparatively complicated spring action embodied in the grip, and in the heavier types permits the grip to be reduced in size. Patent 1711874. Archibald R. Brinkerhoff.

Window Cleaner—For cleaning one surface of a window at a time, and having a special clamping means for fastening the pads, or cleaning elements, on a single staff, by a bail and coiled springs. Patent 1716171. Kenji Horihata.

Household Bin—A tiltable bin having hinged connection with a fixed structure, such as a cabinet, and held to prevent the bin from dropping suddenly when opened or closed, adapted for the storage of coal or other materials. Patent 1716242. Theodore Ritsche.

Folding Dish Rack—Comprising a central portion having corrugations for receiving the dishes, upright ends pivotally secured to the central portion, and locking means for the uprights, the device when collapsed occupies but little space. Patent 1714629. Charles F. Rodin.

Refillable Shaving Brush—Of a sanitary nature, wherein the bristle tuft is comparatively inexpensive, and may be inserted in a handle, secured against rotary movement, used once and discarded. Patent 1716211. Juan A. Cuevas.

Protective Device—A marker adapted to be secured to an article or goods, and which cannot be tampered with, without leaving the device in a condition indicating that a fraudulent attempt has been made to substitute the goods. Patent 1716248. William A. Sonen.

Ventilator—A cowl formation adapted to be placed on top of a ventilating pipe, so that air passing in a horizontal direction will produce a rarefaction, and thereby draw gaseous matter upwardly and force the same to a discharge point. Patent 1717268. Louis J. Sheperd.

Handle Connection for Hand Bags and the Like—Especially designed for women's hand bags, pocketbooks or the like, which in addition to being attractive in appearance is strong and durable, simple in construction and economical to produce. Patent 1717295. Charles Wolf.

Cooker—Wherein food products, necessary in vending hot sandwiches, may be conveniently cooked and retained in a heated and palatable condition by conducting heat and moisture to the bread or rolls to soften and freshen the same. Patent 1717296. Clair G. Wright.

Acoustical Device—Comprising a sound sensitive diaphragm and a dentiphone arm for receiving vibrations, with mouthpiece adapted to be held between the teeth, for enabling deaf persons, or persons hard of hearing, to hear through the teeth. Patent 1717202. John W. Gonce.

Lens-Fitting Attachment—For making a test of the lenses prescribed, in the particular frame which has been selected, and properly adjusted to the head, and for pupillary distance, instead of in what is generally known as a "trial frame." Patent 1717224. John L. King.

Arrangement for Cooling Liquids or Fluids — Which consists in passing the liquid by centrifugal force, and in thin layers, along the inner walls of rotating cylinders, which are formed of heat-conducting material, the outer walls being subjected to a cooling medium. Patent 1717237. Herbert Mager.

Permanent-Waving Cabinet—Designed for use by hairdressers, a cabinet mounted on casters and easily movable, for separately supporting in a conveniently accessible manner the various articles required in carrying out the waving operation without the services of an assistant. Patent 1717217. John L. Izan.

Portable Lighter—Usually referred to as "cigar lighters," so constructed that there is little or no liability of an accidental operation while carried in the pocket, but may be easily operated by one hand. Patent 1717205. David W. Greene.

Ring—Presenting outwardly substantially the same appearance as an ordinary ring, but wherein a book structure is presented having a series of leaves capable of receiving pictures, or preserving mementos, or records of special interest. Patent 1718113. Philip Cohen and Morris Rossein.

Mop—While capable of a wide range of usefulness, it is particularly intended for heavy duty, such as the spreading of tar in roofing work, it is so constructed that a worn head may be easily replaced. Patent 1718137. James H. Griffin.

Sign-Casing Construction—Suitable for producing illuminated effects, whereby panels may be quickly and easily set in place or removed, and held in place without the use of fastening elements such as pins or screws. Patent 1718114. Charles J. Cornell.

Sink Pad—Formed of rubber or other waterproof material, adapted to be positioned between two separate kitchen devices, such as adjacent sinks and wash-tubs, to prevent water dropping therebetween, the water draining into either device. Patent 1718126. Jane Elovson.

Valve—A forged valve, substantially the same size and weight as a similar cast value, where the physical properties of the forging and casting are the same, the valve being readily, convertible from a screw to a flange type. Patent 1717859. Robert H. Thorne.

Food Container—Particularly adapted for carrying luncheon, having a plurality of compartments separated by heat insulating walls, and the exterior being insulated, the box is neat in appearance and may be conveniently carried. Patent 1716367. Frank M. Clayton.

Box—Adapted to be constructed from a cardboard blank or similar material, in which the sides are held together without nails, a reinforcing strip surrounding the upper edge of the box to strengthen the same. Patent 1716757. Alfred H. Beyer.

Portable Lighter — Of the cigar and cigarette lighting type, which may be conveniently carried in the pocket, in which the mechanical parts are not liable to get out of order, and worn or injured parts may be readily replaced. Patent 1718902. David W. Greene.

Rolled Sheet Glass—Which has all of the translucent qualities of ordinary frosted or stippled glass, yet may embody various distinctive and sharply defined designs simulating panelling, the grooves being of V-shape in cross section, and relatively deep. Patent 1718824. Clement Jungers.

Hardware and Tools

Tool—An expansible grinding tool for grinding or honing the cylinders of engines such as automobiles or the like, wherein the grinding elements are automatically expanded to the proper degree during the operation. Patent 1725255. Henry Strand and Byron de K. Jackson.

Oil-Water and Air Separator—Adapted for use with pneumatic tools, such as riveters or hammers, and air brushes, whereby the moisture or oil is brought into contact with wire gauze and separated from the air, without interrupting the normal operation of the tool. Patent 1714825. Emil H. Stephan.

Wrench—Having the dual properties of a pipe wrench and a nut wrench and quickly adjustable means for tne jaws in either use, the handle and jaws acting as a compound lever to cause the jaws to grip any object. Patent 1713038. Amos K. Ersland.

Lift—In the form of a rod with a metal cap and hook at the top, and a transverse bar intermediate its ends, which may be readily employed in removing or placing suitcases or traveling bags upon a shelf. Patent 1716232. Hymen Kantor.

Band-Saw Sharpener—Which is applicable to all standard makes of machines, may be readily adjusted to coincide with the angularity of the saw teeth, and will eliminate the necessity of removing the saw from the machine. Patent 1717206. William Grosskopf.

Well Fishing Tool—Embodying a plurality of various sized bells or sockets, any one of which may be employed in fishing for broken bits or other working tools, according to the diameter of the well. Patent 1717300. Vio A. Asplund.

Pipe or Rod Clamp—A clamp having jaws which may be quickly applied to or removed from the polish rod of an oil well rig, or other similar object, and when applied will positively grip and support the rod. Patent 1718072. Oscar A. Quarnstrom.

Can Opener — Having a spring-pressed pivotally mounted knife adapted to cut the top from the can when the can is revolved by a manually operated wheel, the grip being automatically increased in proportion to the required cutting power. Patent 1718125. Henry J. Edlund.

Offset Boring Head—A construction particularly adapted to metal-working, having an adjustable offset bearing head, whereby the boring or re-boring of holes from practically the smallest to the largest diameter may be accomplished by the same head. Patent 1718089. Edgar J. Tesoroni.

Scissors—In which springs are used which automatically prevent looseness, maintaining a continuous inward pressure on the blades, at a point slightly in advance of the screw fulcrum, and rendering the blades self-sharpening. Patent 1718907. Howell Jordan.

Fastening Means for Hammers and the Like—Having toothed end spring pauls, adjustable to accommodate handles of different types, and for permanently securing the head on the handle, also to permit tightening in the event of wear after long use. Patent 1716605. Stanley J. Shepard.

Heating and Lighting

Oil Burner—For use in domestic heat furnaces, or other places, wherein steam-producing containers are associated with the burner structure for mixing oil and steam with air thus securing a maximum of efficiency for the fuel used. Patent 1715205. Frank X. Mantsion.

Fluid Distributor—For distributing gas in a furnace or oven used for baking purposes, whereby the burners may be regulated to supply flames at different heights at the respective ends, or the gas may be supplied evenly throughout. Patent 1715248. Lloyd H. V. Reynolds and William B. Ensign.

Liquid Heater—In which hot water may be stored for use when required, a thermostat being associated therewith by which the electric heating current is controlled without either supervision or aid, and a special means being provided for opening the electric circuit should the current be turned on while the tank is dry. The inventor has been granted two patents, 1718865 and 1718866. Barnett W. Macy.

Machines and Mechanical Devices

Data-Sheet for Computing Machines and the Like—Which will effectively support a data sheet in position, and easily release the same therefrom, and will allow for the employment of a relatively large sheet, so that a wide range of computations may be displayed. Patent 1715259. Oliver F. Vose.

Method of Extracting Candelilla Wax—Which comprises a crushing and tearing of the plant whereby the wax and non-waxy matter is finely divided and separated from the fibers and screened, instead of carrying the whole bulk of the plant into the vat. Patent 1715194. Jose T. Garcia.

Method of Producing Motion Pictures—In which drawn cartoons, industrial subjects or the like, are combined and properly coordinated with photographically produced scenes of motion pictures, requiring a minimum number of steps and a minimum number of drawings. Patent 1715230. William A. Gilmartin.

Continuous-Settling Device—For settling sedimentary matters from liquids, particularly adapted for use in the paper or sugar making industries, where comparatively large volumes of liquid are to be treated, to have all or most of the solid matter precipitated. Patent 1716228. James Q. Horne.

Lubricator—A manually operable lubricator having a plurality of pumps adapted to be successively operated for supplying lubricant to various moving parts, and in proportions necessary to effect sufficient lubrication at all times. Patent 1716252. Samuel T. Voll.

Folding Cylinder for Printing Presses—A construction wherein, by the addition of certain parts to an old cylinder, two sections of a newspaper may be folded together accurately at high speed and without danger of tearing the sheets of paper. Patent 1717257. George Rasmussen.

Combination Washer and Sterilizer—A single manually operated apparatus for successively washing, rinsing and sterilizing dishes or other articles, and means for holding the cover of the machine closed during the time that these operations are being performed. Patent 1717229. Paul F. Kraeft.

Display Device—For displaying articles to attract attention in the show window of a store, whereby the articles are moved to view and retained in such position periodically, the operation being intermittent. Patent 1717246. Albert Perling.

Perforating Device—Which can be permanently secured to a printing machine without in any way affecting the operation of the machine, and so related to the rest of the machine that perforation takes place only when desired. Patent 1718164. Robert B. Magune.

Cotton Gin—In which spaced disks are provided with teeth on the opposite faces cooperating with either seed deflecting bars or tapered roller, and deflecting plates whereby the seeds and foreign matter of any size are discharged readily while the lint is removed by suction applied directly between the toothed disks. The inventor has been granted two patents, 1717356 and 1717436. Cary S. Cox.

Combined Advertising and Station-Indicating Device—Which may be disposed within a car to automatically display a multiplicity of advertisements one at a time, and will move the name of the next station into observed position when the conductor presses a button. Patent 1716723. John A. and Clarence M. Greer.

Air-Cooling Device—Whereby the air in a room is cooled by the evaporation of a liquid, preferably water, and a forced draft is provided to increase the rate of evaporation, and drive the cooled air through pipes. Patent 1715753. Roland Hardy.

Rotary Grinding Mill—A shell which is elliptical in cross section, revolves on a common axis, and is partially filled with balls or rods so arranged that all the balls or rods will continuously move during the operation of the shell. Patent 1718552. William H. Fluker.

Transmission Mechanism—Having ratchet and pawl elements, the pawls being in actual engagement only during the driving strokes, being moved out of engagement during the idle strokes, thus prolonging the life of the pawls, and eliminating undesirable noise. Patent 1716548. Jules Habrie.

Shaft Coupling—By which the vertical shafts of a rotary pump may be connected, and any required adjustment, as to length to allow of the adaptation of the shaft to a particular mechanism, may be readily accomplished. Patent 1716593. Earl Martin.

Medical and Surgical Devices

Surgical Instruments—Whereby electricity is employed to destroy the tissue, as in the removal of tonsils, but in its association with a source of current, excluded from passing through the patient's body, the sole application being to the tonsil. Patent 1714220. Sutten H. Groff.

Medicine Dropper—Having means for preventing fluid sucked up into the tube from being drawn into the rubber bulb, thus giving a longer life to the bulb which is not subjected to medical action. Patent 1713937. Charles G. Wheeland.

Syringe—In which one end is submerged in liquid in a basin, and firmly maintained at the bottom by a suction cup, the tube producing a siphoning action, and a bulb manually operated forcing the liquid through a nozzle. Patent 1716539. Louis B. de Spain.

Prime Movers and Their Accessories

Gas Timer for Engines—Adapted to be inserted within the usual spark plug opening in a cylinder head of an engine for determining the position of the piston during the firing stroke and when the compressed gases are to be ignited. Patent 1715223. Reiff E. Christ.

Water-Circulation Preheating System for Internal-Combustion Engines—An electric heater disposed between the radiator and the motor and adapted to heat water coming from the motor and cause the hot water to circulate through the motor without interfering with the water in the radiator. Patent 1716715. William B. Whelan.

Rotary Engine—Having radially projectable blade members with which a novel means is employed for preventing centrifugal forces from causing undue frictional engagement with the adjacent stator walls, and means for cooling the valves to prevent warpage. Patent 1717610. John H. McCarthy.

Internal - Combustion Engine — Having telescoping pistons with means for compressing and firing an explosive mixture between them, whereby the pistons are forced in opposite directions so that at each explosion direct power is applied at opposite points on the crank shaft. Patent 1718116. James H. Crary.

Motor with Sleeve Valve—An internal combustion engine of the sleeve valve type, having a steel sleeve valve coated with metal adapted to reduce friction on all surfaces liable to rub against steel surfaces such as the walls or the piston. Patent 1718082. Charles Schaeffer.

Oil Purifier and Gas Separator for Internal-Combustion Engines — Which will serve to subject the crank case oil to a continuous process of filtration and purification, and will separate gasoline from the crank case oil by a continuous process of recirculation and distillation. Patent 1718800. John G. Rea.

Railways and Their Accessories

Railway Tie—A reinforced concrete tie formed of two blocks one positioned beneath each rail, with means for maintaining the blocks in spaced relation, the blocks being tapered toward their ends that they may be securely anchored against endwise displacement. Patent 1718098. Wallace C. Yeomans.

Railroad Joint—For abutting rails, the joint being so constructed that weight passing over it is transferred from one rail to the other smoothly, there being no interruption in support, or flattening of the abutting ends of the rail. Patent 1715837. Charles A. Hunt.

Pertaining to Recreation

Amusement Apparatus—Designed to simulate a race track, which is traversed by objects, in the form of horses or vehicles, the movements of which are brought about by persons competing, to the end that one with greatest skill will win. Patent 1716235. William F. Manning.

Amusement Apparatus—An elevated horizontal support, having a passenger carrying mechanism embodying a plurality of swinging or oscillatory beams equipped with passenger carrying seats, and wherein the beams are actuated continuously by a common drive. Patent 1718167. Philip S. McLaughlin.

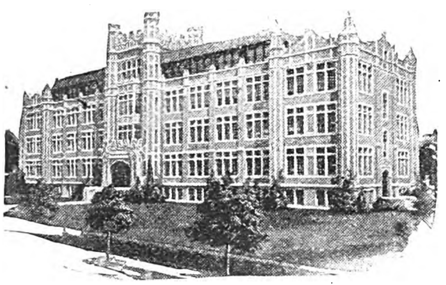
Toy Balloon—Having a stabilizing member arranged to keep the balloon in its course, and to prevent it rolling or turning about its axis when flown as a kite or serving as an advertising medium. Patent 1718508. Leland C. White.

Pertaining to Vehicles

Jacking Attachment—Which will permit the application of a jack to the frame of a motor vehicle, in the rear of the wheels, the movement carrying the axle so that it will be lifted to the same height as the frame. Patent 1715790. Fred Schildman.

Automobile Ash Tray—Having means associated therewith for fastening the same to the door of a vehicle, the ashes and cigarette stubs, etc., being deposited through a suitable yielding cover and through a conduit to the open road. Patent 1715773. Raymond Morales.

Motor Vehicle Top—Of conventional "aerofoil" type, which acts as a wind shield, to deflect a portion of the air over the upper surface of open cars, thereby giving an unobstructed view, a glass wind shield being optional. Patent 1717515. Grant Linton.



Go to High School at Home

You can secure a high school education right at home by studying the splendid new courses recently prepared by the International Correspondence Schools.

These courses are equivalent to the courses given in resident high schools. They have been specially arranged for men and women who wish to meet college entrance examinations, to qualify for a business position, or to make up the education they missed when forced to leave school too soon.

The College Preparatory Course, the High School Commercial Course and the High School English Course include English, algebra, ancient, medieval, modern and U. S. history, physiology, literature, geography, Latin, bookkeeping, drawing, geometry, shorthand, physics, chemistry, salesmanship, advertising, civics, trigonometry, economics, corporation finance, money and banking, business and trade economics and other subjects. A diploma is given at graduation.

The lessons are easy to understand and you will make rapid progress because you will be *in a class by yourself* and you will study under the guidance of instructors who are sincerely interested in helping you to get ahead and achieve the bigger things of life.

Just mark and mail the coupon and we will gladly send you interesting free booklets describing the High School Courses of the International Correspondence Schools or any other subject in which you are interested.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 6110-B, Scranton, Penna.

Without cost or obligation, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

☐ **College Preparatory Course**
☐ **High School Commercial Course**
☐ **High School English Course**
☐ **High School Vocational Course**
☐ **High School Agricultural Course**

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C.P.A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English ☐ Civil Service
☐ Railway Mail Clerk
☐ Common School Subjects
☐ Illustrating ☐ Cartooning

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering
☐ Electric Lighting
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Machine Shop Practice
☐ Railroad Positions
☐ Gas Engine Operating
☐ Civil Engineer
☐ Surveying and Mapping
☐ Plumbing and Heating
☐ Steam Engineering
☐ Radio ☐ Mining
☐ Architect
☐ Architects' Blueprints
☐ Contractor and Builder
☐ Architectural Draftsman
☐ Concrete Builder
☐ Structural Engineer
☐ Chemistry ☐ Pharmacy
☐ Automobile Work
☐ Airplane Engines
☐ Navigation
☐ Agriculture and Poultry
☐ Mathematics

Name..
Street Address..
City..State..........................

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—SEPTEMBER, 1929

American Lead Pencil Co	263
American Pipe Bending Machine Co	263
American Telephone & Telegraph Co	261
American Tobacco Company	Fourth Cover
Baker, Voorhis & Co	257
Bauer & Black	262
Bernard & Heller	265
Charles Bond Company	264
Box 192	260
Chicago Stock Gear Works	264
W. C. Dearing	264
Du Maurier Co	262
Elec. Service & Eng. Bureau (P. O. Box 132)	201
Ethyl Gasoline Corp	Second Cover
Ford Motor Company (Aviation)	198
General Electric Company	194
Gillette Safety Razor Company	193
Hamley & Company	265
Harper & Brothers	259
J. J. Heinrich	265
International Correspondence Schools	272
La Salle Extension University	264
Los Angeles Chamber of Commerce	196
Masonite Corporation	251
Matthews Company	261
Metal Cast Products Company	263
Metallic Sign Letter Co	265
William Mogey & Sons, Inc	264
Munn & Co	260 & 265
National Automotive School	261
National Electrical School	264
National School of Meat Cutting, Inc	264
New Method Mfg. Company	260
Packard Motor Car Company	Third Cover
Pratt Institute	264
Roat & Lohman	265
Schwerdtle Stamp Company	265
Science News-Letter	265
Charles A. Scott	265
Seaver-Williams Company	263
Signal Electric Mfg. Company	263
Stephenson Laboratory	265
Timken Roller Bearing Company	253
Unisol Mfg. Company	263
Veeder-Root, Inc	260
Western Electric Company	255
Henry Zuhr, Inc	265

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

ALBERT A. HOPKINS
ALBERT G. INGALLS
LOUIS S. TREADWELL
A. P. PECK
F. D. MCHUGH
HENRY W. HOUGH
PROFESSOR HENRY NORRIS RUSSELL
PROFESSOR ALEXANDER KLEMIN

CORRESPONDING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

WALDEMAR KAEMPFFERT, Director Rosenwald Industrial Museum, Chicago.

M. LUCKIESH, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.

W. D. PULESTON, Captain, United States Navy—Technical Adviser on Military Matters.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 3. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

05
3A

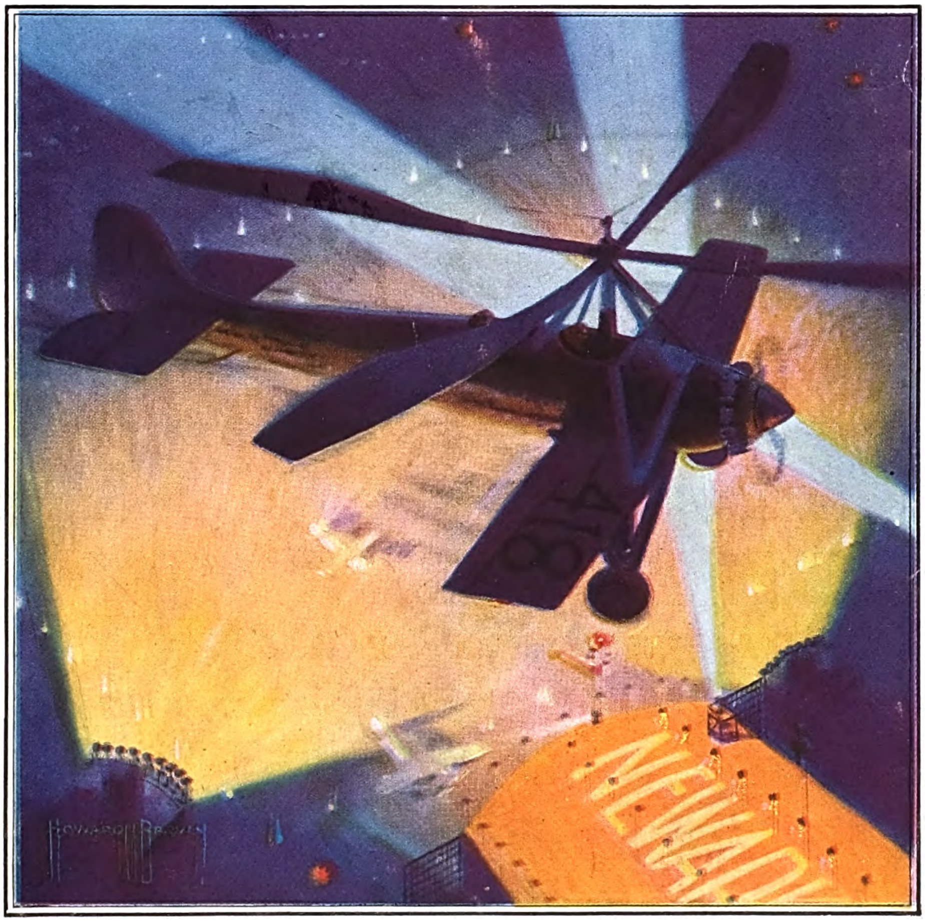
Eng'ng

AVIATION NUMBER

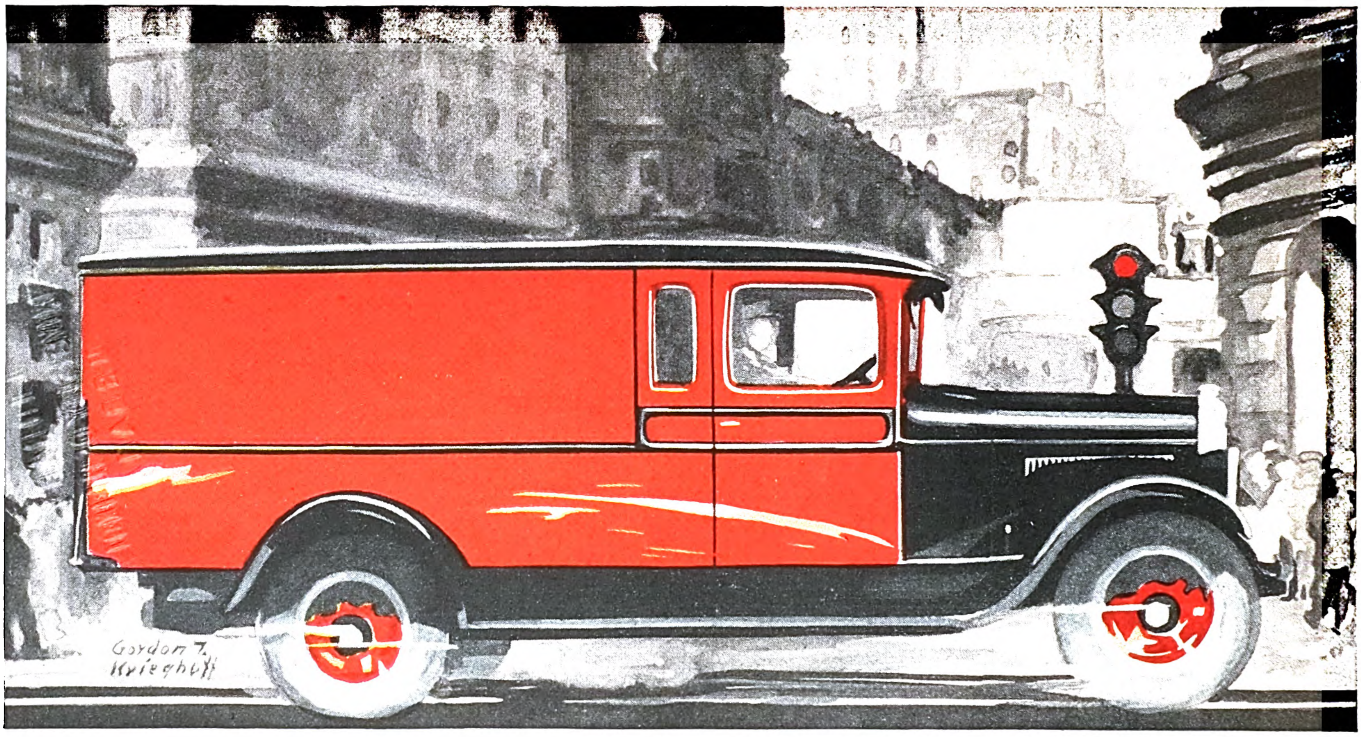
THE LIBRARY OF THE
SEP 17 1929
UNIVERSITY OF ILLINOIS

SCIENTIFIC AMERICAN

October 1929 35¢ a Copy



HOW THE AUTOGIRO FLIES
HOW SHALL WE DESIGN AIRPORTS?
THAT "FATAL" TAILSPIN



Choose a Dodge Truck *safely* from specifications alone

Thousands of Dodge Trucks are selected by experienced business men on the "say so" of satisfied users. Thousands more are purchased after demonstration. Other thousands are bought by those whose own experience has been ample proof of the merit of these Dodge Trucks.

Still there are many, many mechanically-minded users of Dodge Trucks who have made their choice on one basis alone—the facts disclosed by specifications. And their basis of selection has been a safe one because any buyer conversant with truck engineering practice will appreciate the sound design and construction of Dodge Brothers Trucks.

Your local Dodge Brothers dealer will gladly give you the specifications of any Dodge Truck. Compare them with those of other trucks. Check them by an actual inspection of the truck itself. Then form your own conclusions in your own way. We'll gladly rest our case on your experienced judgment.

PRICES

MERCHANTS EXPRESS— 109″ wheelbase (4-cyl.) . .	$ 525
COMMERCIAL TRUCK— 124″ wheelbase (4-cyl.) . .	675
COMMERCIAL TRUCK— 124″ wheelbase (6-cyl.) . .	775
1-TON—133″ wheelbase (4-cyl.) . .	745
1-TON—133″ wheelbase (6-cyl.) . .	845
1-TON—140″ wheelbase (6-cyl.) Heavy Duty	1065
1½-TON—150″ wheelbase (6-cyl.) . .	1345
1½-TON—165″ wheelbase (6 cyl.) . .	1415
2-TON—150″ wheelbase (6-cyl.) . .	1515
2-TON—165″ wheelbase (6-cyl.) . .	1585
3-TON—135″ wheelbase (6-cyl.) . .	1745
3-TON—165″ wheelbase (6-cyl.) . .	1775
3-TON—185″ wheelbase (6-cyl.) . .	1845

Chassis f. o. b. Detroit

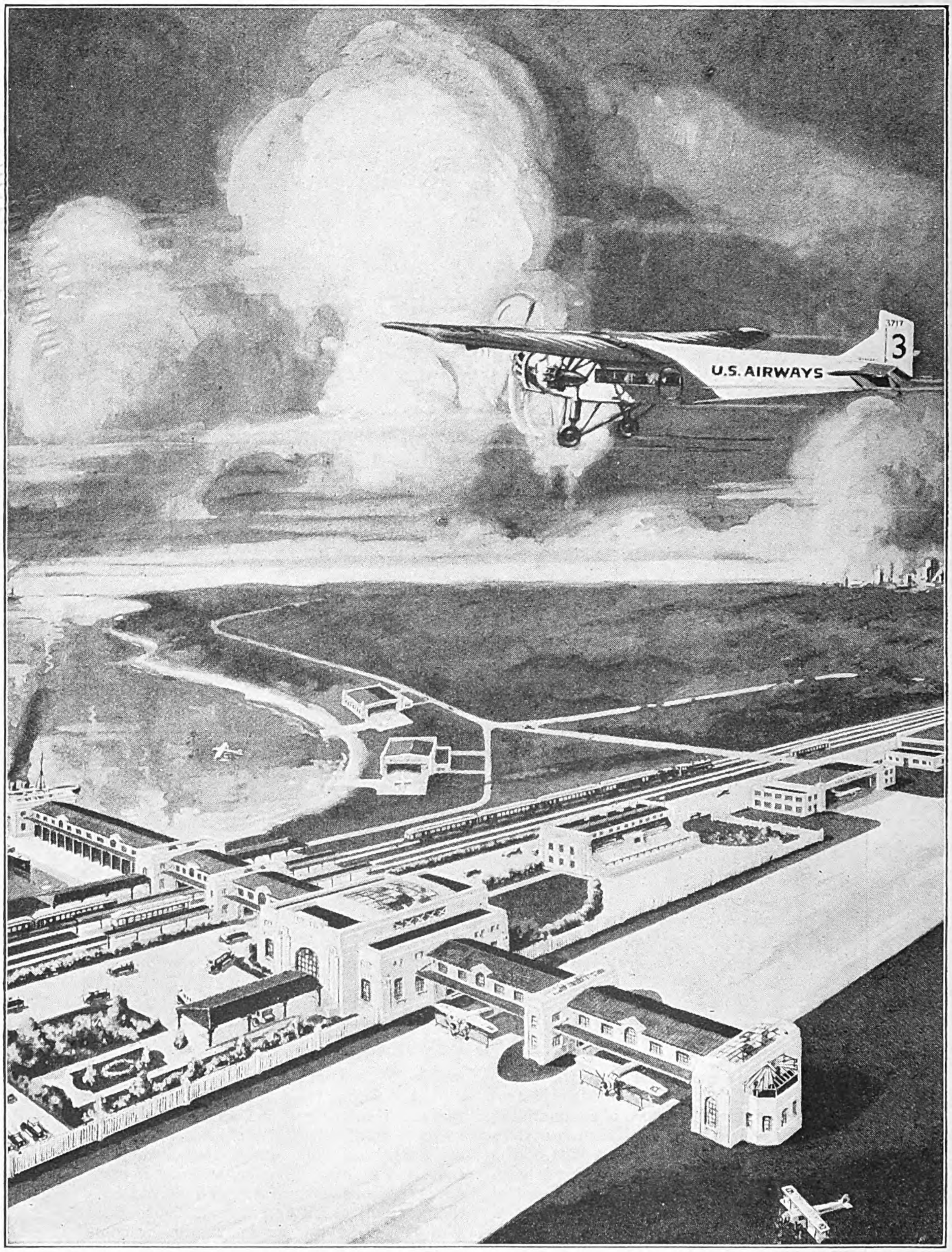
DODGE BROTHERS TRUCKS

CHRYSLER
MOTORS
PRODUCT

SOLD BY DODGE BROTHERS DEALERS EVERYWHERE

Dr. Hugo Eckener

TO even the casual reader of the newspapers, Dr. Eckener needs no formal introduction. His splendid record of commanding heavier-than-air craft through three east to west and two west to east crossings of the Atlantic is now a matter of brilliant aeronautical history. Dr. Eckener was born in Flensburg, Germany, on August 10, 1868, and after university training, in which he specialized in philosophy and meteorology, he became a staff correspondent for the *Frankfurter Zeitung*. In 1909 he became manager of the Aviation Service Company, and in 1912 was made director general. It is said that at one time, when Count Zeppelin was experimenting with his original models, Eckener publicly ridiculed his ideas. Zeppelin resented this, and bitter arguments ensued. Finally Eckener became imbued with Zepplin's enthusiasm and delved into the new subject with great zeal. During the World War he was an instructor for commanders in the naval airship department. In 1922 he became general manager of the Zeppelin Construction Works, and president of the same manufacturing company in 1928.



Design for an Ideal Airport, Adequate in All Respects

WITH connections for all modes of travel—ships at the pier at the left, steam and electric railroads under the bridges of the building, and highways routes—this airplane and seaplane base design represents the last word in airports. The depot itself possesses every facility in the way of offices, waiting rooms, et cetera, for the utmost convenience of passengers. Seaplanes land in the bay and taxi up to the pier, while airplanes land on the field and taxi under the bridges. Passengers are protected from the weather and planes. See the article on page 298.

LLOYD O. YOST
WACO AIRPLANES

FROM COWBOY'S SOMBRERO TO LEATHER HELMET

Will Rogers is a firm believer in the airplane as a regular means of transportation, and he flies whenever possible. His quaint philosophy of life, incorporated in the article which we present below, reveals an outlook that is at once simple, far-seeing, and sincere

Aviation's Patron Saint

The Proof of the Aviation Pudding Is in the Flying. Will Rogers, Famous Unofficial Ambassador, Is Furnishing That Proof in His Daily Business Life

By CARL STEARNS CLANCY

DURING his amazing career from cowboy to diplomat, Will Rogers has garnered many distinctive titles. He has been billed as a broncho-buster, lariat-twirler, circus rider, vaudeville actor, musical-comedy comedian, monolog artist, film star, journalist, lecturer, writer of advertisements, after-dinner speaker, mayor, presidential candidate, congressman-at-large, and unofficial ambassador. None of these titles, however, has pleased him as much as the latest wholly honorary distinction that has recently been conferred upon him—that of "Aviation's Patron Saint."

The first to bestow this unique appellation upon Will Rogers was "Casey" Jones, veteran pilot and president of the Curtiss Flying Service, who has flown Will over many a long aerial trip. Over a year ago, Mr. Jones declared: "After Lindbergh, Will Rogers is aviation's best press agent. The industry owes him more than he is ever likely to collect. His wit, his extraordinary publicity resources, and his genuine enthusiasm for flying entitle him to the nomination as patron saint of aviation." Since then, many other bird-men have enthusiastically seconded this motion.

The latest canvass of the country's airports indicates Will's election by unanimous acclaim. Aviators and ground men in every state declare: "We can always count on Colonel Lindbergh to do the right thing and on Will Rogers to say the right thing at the right time. They are two of a kind." As an example, they point to Lindbergh's action in taking to the air again immediately after his "mishap" with Miss Morrow in Mexico City, and to Will's timely comment upon that event. The following day Will announced:

"I WAS just laying a wager that the minute Lindbergh's arm was able he would take Miss Morrow and fly again when along came the paper saying he did that very thing this morning. I knew he would. Flying is Lindbergh's business. He spent years perfecting himself at it. Because he tips over on his nose once out of a million miles, a lot of editorial writers start howling about it.

"This thing of talking about 'somebody's life being too valuable to risk in an airplane' is not only the bunk; it's an insult to the men we ask to do our flying. Where does anybody's life come in to be any more valuable than anyone else's? Ain't life just as precious to one as another? We have heard that 'can't spare *you*' attitude till we got a lot of men in this country believing it now. Say, get over that old ego. This country will replace you before the folks get home from your funeral.

"So bravo, Lindy, you are a lot bigger tonight than you ever was before, and that's saying a lot. And bravo, little Miss Anne, you have helped aviation more today than you will ever know. And Mr. and Mrs. Morrow, bless your hearts for your splendid help. That's why you gave your daughter to him, because you knew he could take care of her.

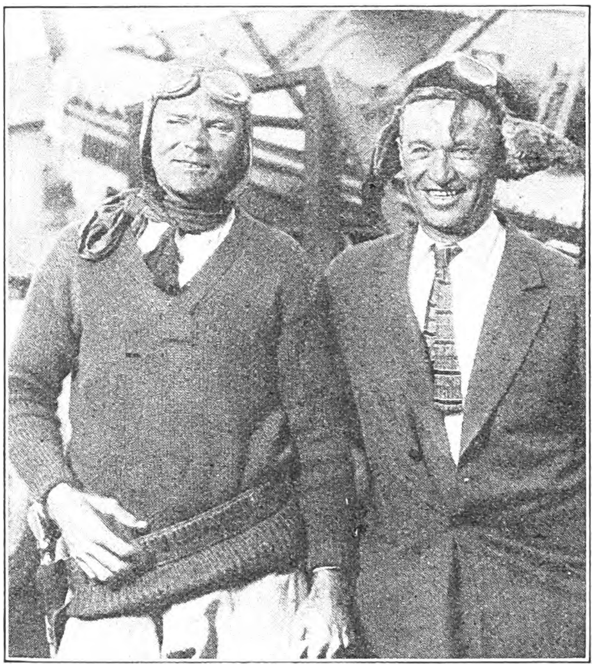
"If flying is dangerous, pass a law and stop it. But don't divide our nation between a class that should fly and one that shouldn't. Aviation is not a fad, it's a necessity and will be our mode of travel long after all the people who are too valuable to fly have met their desired deaths by the roadsides on Sunday afternoons."

Birdmen also proudly call attention to the frequency with which Will Rogers boosts commercial aviation in his magazine articles, on the lecture platform, and from the stage in his untiring endeavor to assist the American public to become airminded. But Will goes even further. He sets everybody a personal example by practising what he preaches. That "Aviation's Patron Saint" is a patron in person as well as by pen is shown by the log which he has kept of his own worldwide travels by air.

MR. ROGERS' enthusiasm for aviation was born during his very first flight. This was made in an army plane in Washington in 1925. Since then he has flown nearly twenty-five thousand miles in a network of lecture tour and journalistic hops over practically every state in the Union and across a dozen countries in Europe. He has ridden in planes and airships of every size and variety and nationality. Now, like Colonel Lindbergh, he never travels by train or motor-car if it is possible to get to his destination by air.

Some of Will's flights have been notable both for distance and daring. In 1926 he flew from Rome to Paris, and from London to Berlin twice, once via Paris and once via Amsterdam. From Berlin, he made an intrepid air excursion to Moscow. During this journey he had to spend a night in a single-motored Russian ship piloted by a dare-devil Bolshevik. He had enough nerve left, however, to fly back by the same route. Will had planned to fly south over the Balkans to Constantinople and back with Mrs. Rogers, but learned just before leaving Berlin that he would not be able to get back in time to catch his return steamer at Cherbourg. Instead, he and his wife flew from Munich to Zurich, where their two younger children were then in school, hired a private hydroplane, and made an aerial sight-seeing tour of the most famous Swiss peaks and lakes. Next, after descending the Rhine by steamer to Cologne, Will again displayed his faith in the airplane by putting Mrs. Rogers and his children on an Imperial Airways Express and waving them off to call on some friends in London, then hopped into a Junkers monoplane himself and flew direct to Paris on business.

When in Europe, Mr. Rogers saw so many fine municipal airports and rode over such a large number of scheduled airlines that he decided, upon his return to the United States, to tour the country on a lecture crusade to awaken Americans to their backwardness in commercial aviation. On this tour he used aerial transportation as frequently as possible and often ended the fears of local reception committees, after the last train had pulled in without bringing him with it, by a last minute arrival by plane.



PILOT AND PASSENGER

This photograph was taken at the completion of a record-making business trip from Los Angeles to New York and return in 81 hours, including the 18 hours spent in New York, and all incidental transfer stops

In the fall of 1927, Will flew from Mexico City to Los Angeles with no less a pilot than Colonel Lindbergh, the man, of all men, Will most admires. Will's joy was increased to the Nth degree when Lindbergh allowed him to hold the control stick part of the way. A few weeks later, Mr. Rogers unwittingly established a new record by making the first round-trip passenger flight in regular mail-planes from Los Angeles to New York and back within four days. This was not a stunt flight. Will had to go to New York on business and he wanted to be back as soon as possible.

ALTHOUGH his air-tickets cost him eight hundred dollars, or twice as much as the train and Pullman fare, the air route saved him a full week's time, and so more than justified its cost.

Will Rogers' confidence in the modern airplane results from the fact that in all his years of flying, both in the United States and abroad, he has never met with a serious accident. And not until he started to fly from Los Angeles to the Republican Convention at Kansas City in June 1928 did he ever experience a "mishap." Everything had gone smoothly until the mail plane in which he was traveling was about to land at Las Vegas, New Mexico, for a new supply of gasoline. Here, upon hitting the surface of the landing field, the plane's right wheel crushed and the machine turned a somersault and landed flat on its back with its pilot and passenger upside down. No one was injured, however. Will merrily exclaimed: "This serves me right for not going to the Democratic convention instead." His first care was to absolve the pilot from all blame and whenever referring to the affair (in the future) he always spoke of it, not as an accident, but as "an incident."

That seemed to be Will's unlucky day, for at Cherokee, Wyoming, late in the afternoon, a section of the landing gear of another plane collapsed and spilled him out on his ear. After the second crash, Will remarked: "Once in a while I've had a horse throw me where I've been underneath him and him topmost, but I've never been thrown like I was today. They're getting easier, however. The first spill wasn't so bad, and the second was almost a pleasure."

WHEN Will was ready to leave Hadley Field, New Jersey, on his first transcontinental flight from New York westward, the weather prospects were exceedingly unpropitious. The ceiling was low and a mean drizzle shortened the visibility. William C. Hopson, an ex-army flyer, was the pilot scheduled for the run to Cleveland. "Hoppie" didn't like the looks of things, but Mr. Rogers was in a hurry to get back to Los Angeles. Before long they got word that it was commencing to clear up out in Pennsylvania, so Hopson decided to start. In spite of the fog, he made it through to Bellefonte, and then on to Cleveland on schedule time. A year later, however, when flying the mail eastward from Cleveland, "Hoppie" became lost in the fog, crashed into one of Pennsylvania's mountains, and was killed. The next morning, Will Rogers, remembering his brave pilot, published the following tribute:

"New York, Oct. 19.—It was a dark, rainy, cloudy day on the New York end of the transcontinental airmail. No planes through in two days. I wanted to get home to my family in California. I insisted on going. It wasn't bravery—it was dumb ignorance and unlimited confidence in all airmail pilots.

"I kinder feel like his skill saved my life that day. So 'Hoppy' old boy, here's hoping you are piloting the best cloud the Boss has got in His hangar up there, and that you don't have to worry about low ceiling, engine missing, head winds, or even the old ripcord will pull in case— Yours, Will Rogers."

During both his 1926 and 1927 lecture tours, Will related his aerial adventures abroad, described the network of Europe's airways and the safety of airplane travel as demonstrated by England's, France's, and Germany's traffic and accident records, then pointed out the potentialities of airplane travel in this country and enlarged upon its pleasures and benefits. During those years, practically the only aerial passenger service this country afforded was that of the transcontinental mail planes. To-day, Will has the satisfaction of being able to praise the service of the numerous well equipped mail and passenger lines that have since been established.

"WHAT a great bunch of men we've now in the air," he exclaims. "The pilots are all ex-army or navy men, so you don't have to stop to figure which is safer, a plane or a car. All you have to do is to compare the intelligence of the men who pilot these planes with that of the average person who drives a car. You know, I am a coward at heart. I am scared of everything. But I've got so much confidence in these pilots I just climb up in there like a baby crawling up into his mother's arms. Why, these fellows are the most careful flyers in the world. They have flown long enough to know the danger of it. They never purposely take a chance. I always figure their lives are worth more than mine. I've lived mine and had my fling, while most of theirs is still in front of them; so if they are willing to go, I am. They don't have to take off unless they want to. It's up to them. They are the last word. The company knows they will go if it's physically possible to do so, and they let them decide.

"In case of any kind of danger, these real pilots have half a dozen things up their sleeves to do. I will get in a plane and start for the Fiji Islands with an army, navy, or mail pilot if he thinks he can make it. One of the reasons why Lindbergh is such a great flyer is because he came from the army and airmail schools. The army, navy, and mail are the three sure-fire instruction branches. But it's not only the men, it's the equipment that makes traveling with them safe. Never forget the ground men. Successful operation depends upon careful inspection and skillful workmen at the hangars. Nobody says much about the ground crew. Yet without them the airmail could not have been flown millions of miles last year with so few mishaps. I don't advise flying with anybody that happens to have a thing that is shaped like an airplane. But I do advise with the utmost confidence, anyone flying with our real recognized passenger lines."

WHEN asked if he ever gets "air sick," Will replied: "Now the air is just the same as the ocean. I'm making no alibis for it. If it's windy and rough, you are liable to feel your stomach rising and falling with the plane. But if it's nice and smooth, as it usually is on a pleasant day, there's not a chance in the world of anyone's getting sick.

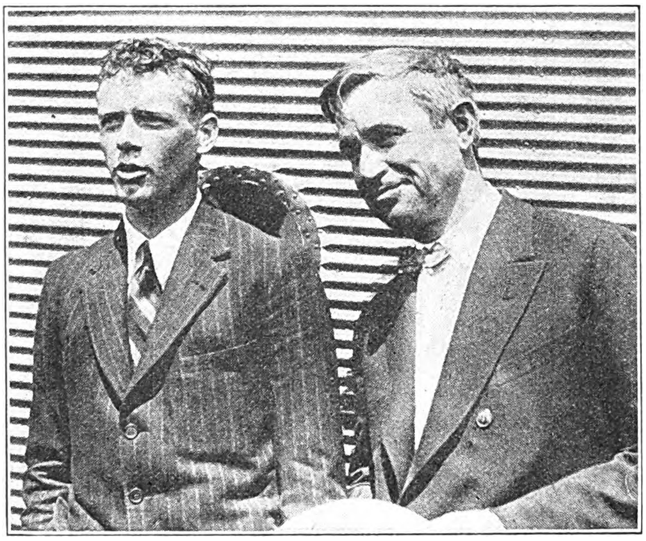
"But what you want to think about," he continued, "is the fun of flying. Why, it's like sitting astride a lively cloud and sailing over the earth with a marvelous ever-changing mountain-top view beneath you. In the east you get the colorful panoramas of spring's tender greens and autumn's gorgeous foliage. Out west you soar over magnificent painted deserts lonesome as the moon, except for the lighthouse keepers' houses that look just big enough to keep matches in, near the occasional light-towers that mark the route. Then you strike a valley with pretty little ranches all along the edges, and feel as if you were back on earth again. And here's another great thing about air travel. Even if you go over a country one way and come back by the very same route, the whole thing looks different to you. It's because you're seeing it from exactly the opposite angle. Yet you will swear you didn't come that way before.

"But, glorious as it is, flying during the day is like slumming compared to night flying, with the revolving searchlight beams of the beacons to guide you below,—especially the thrill of sailing over a big lighted city at night. Below, you see hundreds of lighted rows of streets running in every direction, the dark outlines of the rivers and lakes, and the thousands of automobile headlights that dart around like bugs. And the greatest thrill of all is when you glide down, in ever narrowing circles, to a well lighted field at night, with planes coming in and leaving. It just reminds you of a carnival or of Coney Island. It makes you feel we are getting somewhere with our aviation. There is not much of a kick in coming into a railroad depot. All you see is the sides of other cars. But when you swoop down out of the darkness into all this flood of light and efficiency—well, you'll just have to experience the sensation yourself, that's all!

"Speaking of those tiny desert lighthouses reminds me of the real folks I met in a praire lighthouse once. Most people don't know such a thing as a lighthouse keeper in the middle of the prairie even exists. One time when I was flying from Beverly Hills to Chicago in a mail plane, we had to buck a head-wind so long we ran short of fuel and had to stop at an emergency landing field next to one of these inland lighthouses in the middle of Wyoming to 'gas her up.' Well, there is where I met my first lighthouse keeper, a real honest-to-goodness one that works for Uncle Sam and stays there twenty-five miles from the nearest post office three hundred and sixty-five days a year, just to keep the tower light burning to guide wayfarers on their route, the same as if he was out on a lonely island off a desolate rockbound coast.

"THE tower had a big revolving light on top of it. At its base was a little powerhouse containing the electric motor that runs the beacon and all the lights that were around the field. These lighthouses are strung clear across the continent to guide airmail pilots at night. Between New York and Chicago they are ten miles apart. In the west, they stand twenty-five miles distant, but in between, just about every three miles, are small flicker lights. These are controlled by the sun's rays and go on when the sun goes down. No one has to tend them. At least one light is always in sight, barring fog.

"Well, here lives the keeper and his wife in a tiny box house, partitioned into three little rooms. They have no neighbors, but they know all the pilots on the run, their joys and their sor-



"TWO BEST PRESS AGENTS"

Col. Charles A. Lindbergh and Will Rogers have been rightly called the two best press agents in aviation today

KNOW HIM?
Disguised by a flopping Panama hat, Will Rogers is given away by the nearby plane

rows, and always watch for them to stop, or to wave at them when they pass. When night comes on, the keeper goes out and turns on the lights that outline the field, then the big tower light. Each keeper gets a hundred dollars a month from the Department of Commerce, with house and fuel furnished. I found this lighthouse keeper's wife a mighty cheerful and wholesome middle-aged woman. She wasn't interested much in a permanent wave, or reducing, but she did bake some of the best bread and make some of the best coffee I have had in years. They have two sons in college and are two of the finest folks I ever met."

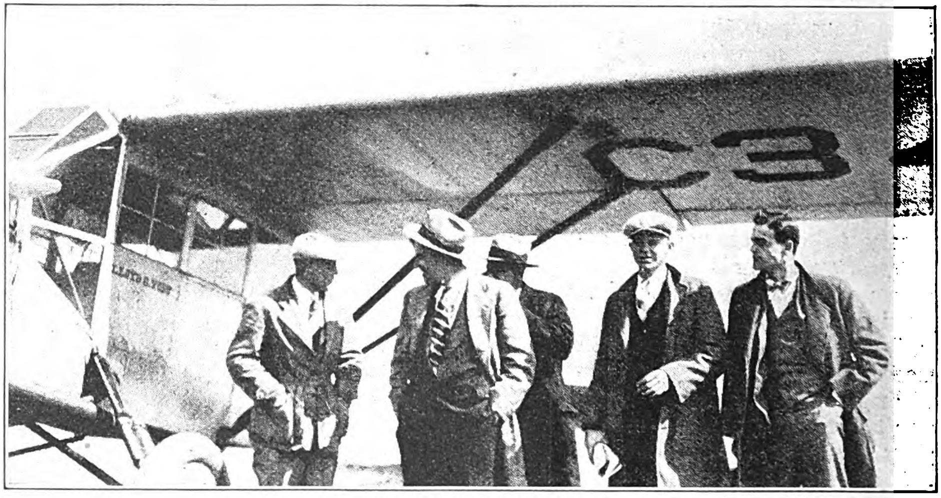
ALTHOUGH accustomed to cracking jokes about other people, Will seldom plays them on himself. Last season, however, he unwittingly stuck himself into a most colorful pickle. On one of his lecture tour jumps—it was between St. Petersburg and Pensacola, Florida—the pilot lost his bearings even in the day time and had to land in a field in order to find out the name of the adjacent town. This predicament so deeply impressed Will's mind with the need of having all towns identify themselves from the air, that he immediately began to campaign for this innovation. Later he even went so far as to publish an offer to pay for the paint used by every town which would label itself for the benefit of sky-riders. The response to this offer was nation wide and of startling proportions. Soon poor Will was snowed under with paint bills. Some towns jokingly pretended they thought he was bluffing and "called him" by requesting him to send the money in advance.

"Well," Mr. Rogers laments, "right there is where I stepped into paint plum up to and over my financial neck. Say, Sherwin Williams didn't have enough to have supplied the demand. I started with an awful poor idea of the number of towns in this country. I sure did mean well, but I just gnawed off more than I could chew. For instance, Pontiac, Michigan, sent me a bill for 98 dollars. I thought somebody must be going into the paint business up there. But they told me they had some pretty big building up there. If they've got buildings that big, however, I'm going to fly up there and land on 'em some day. The *Saratoga* ain't that big, and all the Navy lands on it.

"Yet Pierce City, Missouri, with three more letters in its name, sent me a bill for four dollars and a half. It is a nice beautiful little city down next to Oklahoma. You see, the nearer they get to Oklahoma the more honest and economical they are.

"The Kansas City Chamber of Commerce advised me that the state at that time was having a Paint and Clean Up Week and asked would I mind just including enough to paint and clean up Kansas. Now can you imagine me cleaning up Kansas? Can you imagine anybody cleaning up Kansas? Even Carrie Nation couldn't do it.

"Wichita Falls, Texas, put in a bill for only two forty. See, that's the kind of people you meet in a Democratic state. The minute you get out of Republican territory you see honesty and square dealing creeping in. Brasstown, North Carolina, had enough sense of humor to paint their name in public and charge me only ten dollars for it. That's fair, for there is a sprinkling of Republicans in that state, and you can see just a fringe of corruption creeping in.



LOOKING IT OVER
"This thing of talking about 'somebody's life being too valuable to risk in an airplane' is not only the bunk; it's an insult to the men we ask to do our flying," is Will Rogers' viewpoint

"Chewraw, South Carolina, wrote: 'Send two quarts of yellow paint. Two bucks. Put up or apologize.' See, that's down south with the Democrats, too. No corruption. No scandal. They only want what it takes. From out in the west, Ontario, California, wrote: 'This is a strong Republican district, and if too much oil paint is used we might be drawn into the oil scandal. So 25 dollars will cover everything.' See, there is Chewraw for two dollars and Ontario for twenty five. One Democratic and the other Republican. Chewraw only wants to print its name. Ontario only wants to cover everything."

WILL'S altruism soon became too costly even for his plump purse, so he was forced to limit his offer to towns with four letter names, then to three letter names, and finally to the furnishing of the paintbrush alone. But the nation-wide publicity he secured for the air-man's needs and the agitation he started completed his work. Recently, the Kansas legislature has passed a law requiring every town in the state to brand itself for bird's-eye identification, and other states now have the same legislation under consideration.

Will's enthusiasm increases with the years. He declares he is going to keep on flying until his beard gets caught in the propeller. Now he is actively campaigning for "a municipal airport for every city!" and "a landing fair-way on every golf course!" Here again he has set the example by making possible the use of one of the polo fields on his California ranch as a landing field. Surely, if anyone deserves to go down in history as the "Patron Saint of Aviation," it is Will Rogers.

¶ *Will Rogers tells above of the joys and convenience of flying. Starting on page 324 of this issue, Professor Alexander Klemin, of the Daniel Guggenheim School of Aeronautics, gives the facts of aerial transportation as it is carried on in the United States today.* —The Editor.

OUR POINT OF VIEW

An Inventor Passes

A CAREER of remarkable achievement ended on August 3 with the death, in Washington, of Emile Berliner, inventor of the gramophone, the first disk record talking machine, and of the telephone transmitter from which has evolved the radio microphone of today. Mr. Berliner was 79 years of age.

An immigrant from Hannover, Germany, in 1870, Mr. Berliner sold glue, painted backgrounds on photographic enlargements, was a traveling salesman, and in 1877 became a store clerk in Washington. His inventive genius soon manifested itself when, after experimenting in his spare hours, he invented the loose-contact transmitter which placed the telephone on a commercial basis three years after its invention by Bell and Watts. Then came the gramophone and his invention of the present method of duplicating disk records. He worked on a helicopter before the Wright brothers' success with the airplane, traced the cause of high infant mortality to raw milk, invented the first light-weight internal combustion engine for aircraft, and developed acoustical devices.

Mr. Berliner was, as the saying goes, a man of parts; his versatile genius is reflected in a large number of remarkable inventions in everyday use all over the world. He was the recipient of high honors and several medals, and wrote many articles and books. An article concerning Mr. Berliner and his many inventions was published in the pages of the July, 1927 issue of the SCIENTIFIC AMERICAN.

Our Naval Adviser

THERE is no subject of more abiding interest to our readers than their military forces, their Army and their Navy. The development of these two services must keep abreast of the industrial development of our country and yet in time of peace we are prone either to forget entirely these two sister services, or to take their efficient state of preparedness for granted.

The difficulty many civilian readers have in following the technicalities inseparable from modern military weapons is doubtless responsible for their apparent lack of interest in military matters. In the past the SCIENTIFIC AMERICAN has from time to time offered its readers articles on the military which, although strictly accurate, were stripped of technical terms and readily understood by its readers. In order to continue to keep pace with military developments and to maintain our traditional reputation as disseminator of authoritative military information, we have added to our list of corresponding editors, Captain W. D. Puleston of the U. S. Navy, who will serve as Technical Adviser in Military Matters.

Captain Puleston was graduated from Annapolis in 1902, from the Naval War College in 1915, and from the Army War College in 1925. He served in connection with the Naval War College Staff in 1915 and 1916, and in all naval grades from Midshipman to Captain has spent 17½ years at sea. During the World War, he served in 1917 on the staff of the Commander-in-Chief of the Asiatic Fleet as Fleet Gunnery Officer, and in 1918 in command of the destroyer *Cushing* in the war zone. For his war service he was honored with the award of the Navy Cross.

CAPTAIN W. D. PULESTON, U. S. N.

Captain Puleston in 1916 collaborated with Admiral Knight in preparing a history of the Naval War College, and has reviewed several books for the United States Naval Institute. In 1926 he published "The Dardenelles Expedition," a condensed study of that amphibious undertaking which has gone into two editions and which has been recently accepted by military students as authoritative and by civilian readers as clear and concise. This book has been pronounced correct in all essentials by General von Sanders and General Sir Ian Hamilton, K.C.B., the opposing leaders—truly a unique tribute to its fairness of exposition.

Captain Puleston's treatment of the expedition in the Dardenelles is sufficient justification for expecting that he will be equally unbiased and illuminating in what he writes—on Army and Navy matters—for these pages. Coupled with this is the fact that his varied experience afloat and ashore qualifies him to keep SCIENTIFIC AMERICAN readers accurately informed of their Navy. His connection with SCIENTIFIC AMERICAN as Technical Adviser on Military Matters has received the approval of his superiors.

We count ourselves fortunate.

Seeking Genius

TOO often or, we might say, practically always the embryo genius is left to find himself; he is seldom sought out, given special attention, and his intellect nurtured to maturity as it should be. The result, perhaps, is that after a severe struggle against handicaps, he may or may not attain the eminence that is rightfully his. "At present," recently stated Professor N. E. Gordon of Johns Hopkins University, "we are simply dependent upon the chance possession of wealth, health, perseverance, social rank, and self-denial to save the highly endowed for the progress of our race."

Possible future geniuses in chemistry, however, are going to be sought out and given more individual attention at Johns Hopkins. Mr. Francis P. Garvan, president of the Chemical Foundation, has endowed a "super-chemists" chair at that university and already nine students are ready to embark on the new course under Professor Gordon, in the fall. Nominated by chemical companies in the states of their residence, these men are to be left to the research of their choice without outside dictation. Later, 48 students will be selected in like manner, one from each state, their attributes being judged by the following percentages: health, 7.8; creative ability, 13.7; book ability, 7.3; intellectual honesty, 11; perseverance, 8.9; faculty of observation, 10.1; enthusiasm, 8.9; conduct 7.8; character, 9.2; and college standing, 15.3.

How these figures were arrived at has not been told but to us they seem a fairly efficient group of ratings. Relative values indicated are interesting, particularly as we note that health is but a poor second from the bottom of the list and is an even tie with conduct. College standing seems somewhat high since our observation has been that often this is the direct result of book ability, which is here rated lowest, and not at all the indication of superior imaginative intellect. We believe, further, that imagination, *per se*, should be given a relatively high rating in this list. Social rank and wealth are not included, obviously because, although these would give a man certain freedom from handicaps, genius is very often found among those having neither. Whether the ratings, as a whole, will prove a touchstone for the discovery of genius, only much experience in using them can determine.

Parity and the Public

THERE is today no question that has a more significant bearing on international comity than that of armaments. The question of limiting armies and navies has threatened more, perhaps, than anything else, to nullify the post-war efforts of nations to create a leading sentiment against war. Particularly has the discussion of naval limitations engendered distrust and suspicion of the motives of England and America among not only the peoples of these two nations but also among those who are not so vitally affected by the problem.

The extent to which navies shall be limited, how great should be the cut in peace-time armies, and just what degree of preparedness is concomitant with the spirit of the Kellogg Pact are all moot questions and as difficult to follow in their many ramifications as they are difficult of solution.

The SCIENTIFIC AMERICAN will follow the efforts of the naval yardstick makers closely and promises its readers to keep them thoroughly informed of events as they transpire. Its interest in naval affairs is no new departure; several decades ago when we had temporarily lost our sea consciousness the SCIENTIFIC AMERICAN published articles by Mahan who, although well known in Europe, was almost unknown in his own country. It hopes that the veil of secrecy so carefully thrown around the 1921 conference will not be considered necessary by the present administration. Both Great Britain and the United States are accustomed to freedom of the press; eventually all negotiations must be made public, and a yardstick that can accurately measure men-of-war can not be hid in a closet.

Rightly or wrongly, many Americans still consider that they voluntarily relinquished naval supremacy in 1921 and that, in the meanwhile, Great Britain has built up her strength in cruisers until she has recovered actual supremacy. No good will come from concealment of further American sacrifices even if it leads to temporary official accord. Britain and the United States are both accustomed to forming their own public opinion and neither can be long imposed upon by government statements. So the governments of both countries will be well advised to avoid such closet diplomacy and to remember that the British and the American public can bear the plain-spoken truth.

Further, no lasting concord will exist unless founded on parity, neither country will brook second place, and both are navy-minded enough to remember that Germany's second-best navy could not keep open Germany's ports during the World War. If Britain is dependent on the high seas for food, the United States depends on outside sources for rubber, manganese, and many other articles essential to her daily life; if Britain has commerce on the Seven Seas so has the United States, and if the British merchant marine exceeds, then the American cargo exposed to enemy capture is equal to that of Great Britain at present and is fast exceeding it. Our stake on the ocean, subject to belligerent interference even when we are neutral, is too enormous to confide longer to the protection of any other navy than our own.

Allan Curtiss Hoffman

IT becomes our sad duty to record the death of Allan Curtiss Hoffman which occurred on July 21, 1929, at his home in Englewood, New Jersey, after a short illness.

Associated with SCIENTIFIC AMERICAN in 1913 as Advertising Manager, after previous experience in magazine publication, he became Secretary of the Scientific American Publishing Company in October, 1918, and Secretary-Treasurer in 1924. His active business connection ceased in June, 1928, but he remained a Director to the time of his death. During the past year he has been executive Vice-President of American Cirrus Engines, Inc.

Of amiable and pleasing personality he readily made friends and held them. To all tasks he brought enthusiasm and concentration which urged to a thorough analysis and his counsel was readily sought throughout a wide acquaintance. As a governor of the Englewood Hospital he directed all the publicity of the successful endowment drive two years ago, and during the war was very active in the Liberty Loan and Red Cross drives.

He leaves a wife, a married daughter, and a son just graduated from Yale.

We embrace this opportunity to affirm our appreciation of his wise counsel and warm friendship which will be greatly missed.

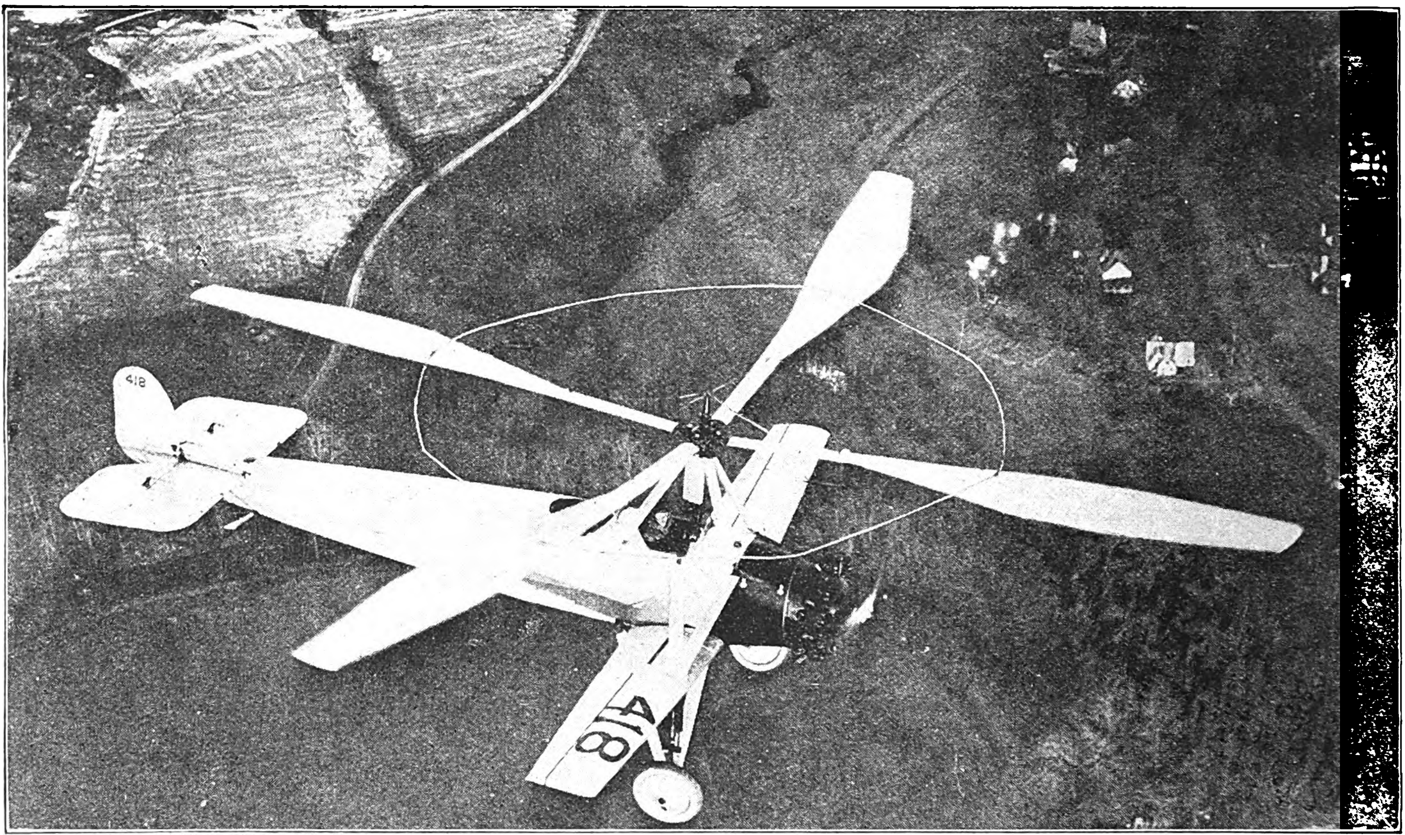
Finally, we cannot escape the conviction that Great Britain will make a most serious error if it endeavors for any specious reasons to relegate the American Navy to second place, for even if it should succeed for the moment, the lapse of a few short years would reveal the disparity to keen American eyes, and then the American public would be forever convinced that it is worse than futile to negotiate further with Britain. And this conviction would have an ill effect on British-American relations that would be difficult to over-estimate. Nor should the British people quickly forget that had the United States possessed a stronger navy in April, 1917, they would certainly have been spared some anxiety and perhaps the last year of the war.

Wooden Nutmegs

EVEN long before the supplanting of the itinerant peddler of New England by automobiles and modern merchandising methods, wooden nutmegs had passed the heyday of their "popularity" and housewives refused to be taken in by the petty penny-grabbing peddlers. Yet in these days of universal enlightenment, wooden nutmeg methods are still more viciously applied to the selling of many articles, one of the most important being ordinary eyeglasses, or spectacles.

The eyesight of thousands of persons is being jeopardized by spectacles sold by unscrupulous mail order houses, according to the Society for the Prevention of Blindness. The Society brands the operations of these firms as "both a fraud and a menace." Obviously, without a proper examination, it is impossible to fit glasses to the eyes of the individual, but these quack firms glibly advertise that their "splendid glasses will enable anyone to read the smallest print, et cetera, and prevent eye strain and headaches." The spectacles they send on orders are simply magnifying lenses in cheap frames and will not fit any eyes except by the merest chance. The deplorable result of wearing these magnifiers is that many disease conditions which ordinarily result in total or partial blindness may be temporarily concealed and not be discovered until it is too late to correct them by legitimate fitting of glasses or other means of eye treatment which are readily available.

The public is warned not only not to use such spectacles but also to discourage their use by others. No one was really harmed by wooden nutmegs—in fact they have furnished much amusement even to those who were credulous enough to buy them—but mail order spectacles are dangerous and those who sell them are among the very vilest of quacks.



All photographs courtesy Pitcairn-Cierva Autogiro Co.

THE AUTOGIRO IN FLIGHT

This unusual photograph of an autogiro in flight was taken when C. J. Faulkner was piloting it over Pitcairn Field, Philadelphia, Pennsylvania. Notice the cable connecting the four vanes. This could be dispensed with in flight, but is necessary when starting

How the Autogiro Flies*

A Non-Technical Explanation of the Operation and Performance of the Aircraft Dubbed the "Flying Windmill"

By EARL D. OSBORN
Contributing Editor of *Aviation*

CHANGES in any art, when they portend revolutionary developments, are always intriguing, but when the background of the subject is complicated, it is seldom that the inwardness of it is brought out in such a manner that the layman can grasp the fundamentals. Here is an exceptional case. The author of the accompanying article has explained the operation of the "flying windmill" in such a way that one need not have a thorough knowledge of aerodynamics to understand.

It is early as yet to predict a future for the autogiro, but its evolution will be interesting to follow, and it is entirely possible that its principle of operation, or discoveries made in the course of experimental work, may play a large part in the future of commercial and civil flying.—*The Editor.*

DROP an airplane vertically and it will move forward, even though it is held in a horizontal position which prevents it from assuming a normal gliding angle. If one wing of the airplane be put on backwards and the plane again dropped, it will spin around.

This is the essential fact to be remembered in considering the principles of the autogiro. The aerodynamics of the machine are in reality extremely complicated, but if one remembers that it is an upward current of air directed against the under sides of the blades of the rotor which causes its rotation, it is much easier to understand how and why the machine flies. The forward motion of the autogiro only indirectly causes the rotor to turn. The turning motion is produced because the rotor is tipped back to the angle of flight and a certain part of the air flow caused by the forward motion strikes the blades from underneath and causes them to turn. If the rotor or windmill, as it is popularly called, were kept absolutely parallel to the air, it would slow down but, as soon as it did, the autogiro would start to sink and the air would again strike it from underneath and cause the speed of rotation to increase. The only way, barring accident, in which the rotor can be stopped in flight is by putting the machine in a dive which is so steep that the rotor will be absolutely vertical and in line with the path of descent.

TO start the rotor turning, the machine has hitherto been taxied along the ground. As the mast about which the rotor turns is raked back in relation to the fuselage and the line of propeller thrust, the rotor is tilted with its rear lower than the front. When the machine moves forward, the angle causes part of the wind to strike the blades from underneath and this starts the rotation. When the blades get rotating fast enough (about 80 or 90 revolutions per minute), the machine is ready to take off. The climb is accomplished by having the machine tilted to a considerable extent in regard to the line of flight. If the stick is pulled too far back and the angle becomes too steep, the machine will begin to settle, but this merely increases the upward action of the wind against the bottom

---

*Reprinted by permission of *Aviation.*

of the blades, causing them to rotate faster. When the desired altitude is reached the plane is leveled off, but the rotor is always kept at a slight angle to the path of flight.

In the first models of the autogiro, which were built more than nine years ago, the blades of the rotor were fixed. On all subsequent models, the blades have been fastened to the vertical shaft through the medium of universal joints which allow the blades to move up and down and also to move closer together or farther apart. The universal joint, like the joint on an automobile drive shaft, allows movement in any direction but prohibits rotation. Once the rotor has started to turn, centrifugal force tends to hold the blades out horizontally or rather at right angles to the shaft.

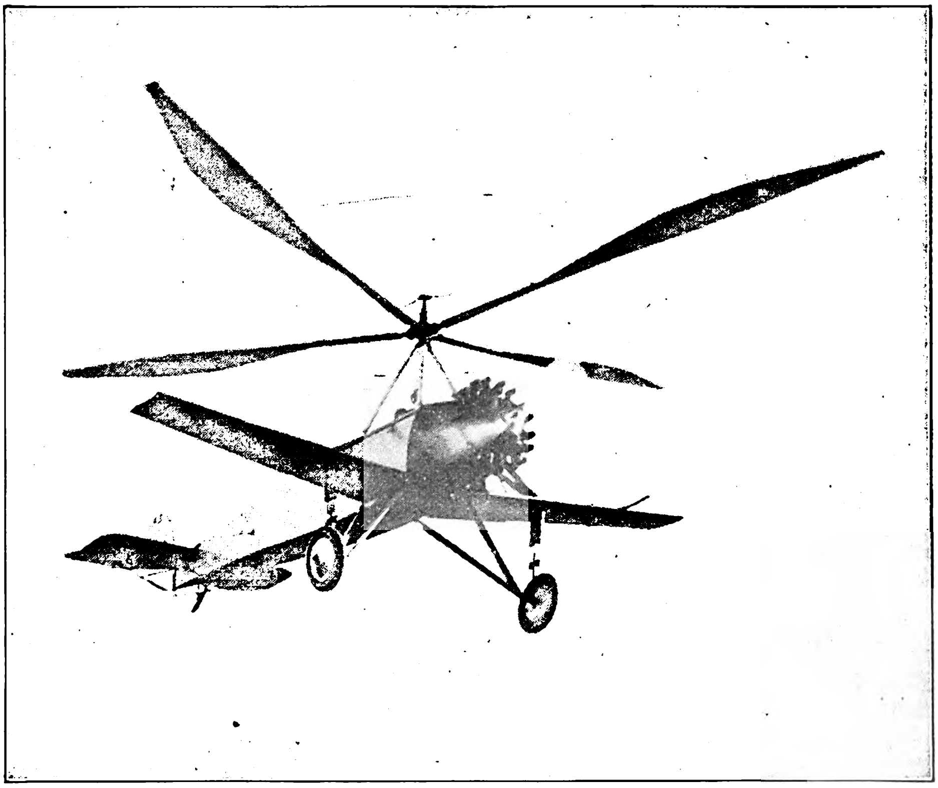
The centrifugal force also tends to keep the blades equally spaced around the circumference of the rotor. However, when the rotor is turning very slowly, or when it is idle, the blades would droop to the ground and might bunch together. (For storage, the blades are all folded back and arranged parallel to the fuselage.) To prevent the drooping and bunching while starting the rotor, it has been necessary to hold each blade up by a cable which runs to the top of the mast. It has also been necessary to keep the spacing of the blades by means of cables and shock-absorber cord between each of the blades. As soon as the rotor starts turning, the centrifugal force keeps the blades in the proper position and the cables could be entirely dispensed with, which would increase efficiency and improve the looks and simplicity of the machine. Especially when taxying, to start the turning of the rotor, care must be taken to see that too much stress is not put on the cables.

THE fact that the rotors are hinged on a universal joint is a point the significance of which is not immediately grasped by those whose minds have been accustomed to think along lines of airplane structures. It means that the blades of an autogiro do not have any very great bending stress as do the wings of an airplane. Practically all the stress is in tension. The blades lift, but the lift is transmitted to the autogiro through means of centrifugal force. The lift of the blades tends to move them up to a vertical position while the centrifugal force tends to hold them horizontal. The effect is much as if the autogiro were fastened to the middle of a rope. If the two ends of the rope were pulled apart, the machine would be raised up but the strains on the rope would be only tensional. When the autogiro hits a severe bump or is pulled suddenly out of a dive, the lift of the wings becomes greater than the centrifugal force and the wings rise up momentarily above their normal position, but the forces on the hinges remain tensional.

In the autogiro, the angle of incidence (that is, the angle at which the blades are set in relation to the fuselage) remains the same but the angle of attack (that is, the angle at which the blades meet the air) is varied by allowing the wings to move up and down. The result is that the blade which is going down wind has approximately the same lift as the blade which is going against the wind. The details of the aerodynamics involved are extremely hard to grasp, even scientists seeming to differ, but the general principle is that the blade going against the wind rises and receives more wind from the top and less from the bottom. This decreases its angle of attack which decreases its lift. When the blade starts going down wind, centrifugal force moves it down again, which means that more wind strikes it from underneath increasing the angle of attack and thereby increasing its lift. The wings are also hinged so that their spacing can be changed and the blade moving against the wind tends to catch up to the other blades.

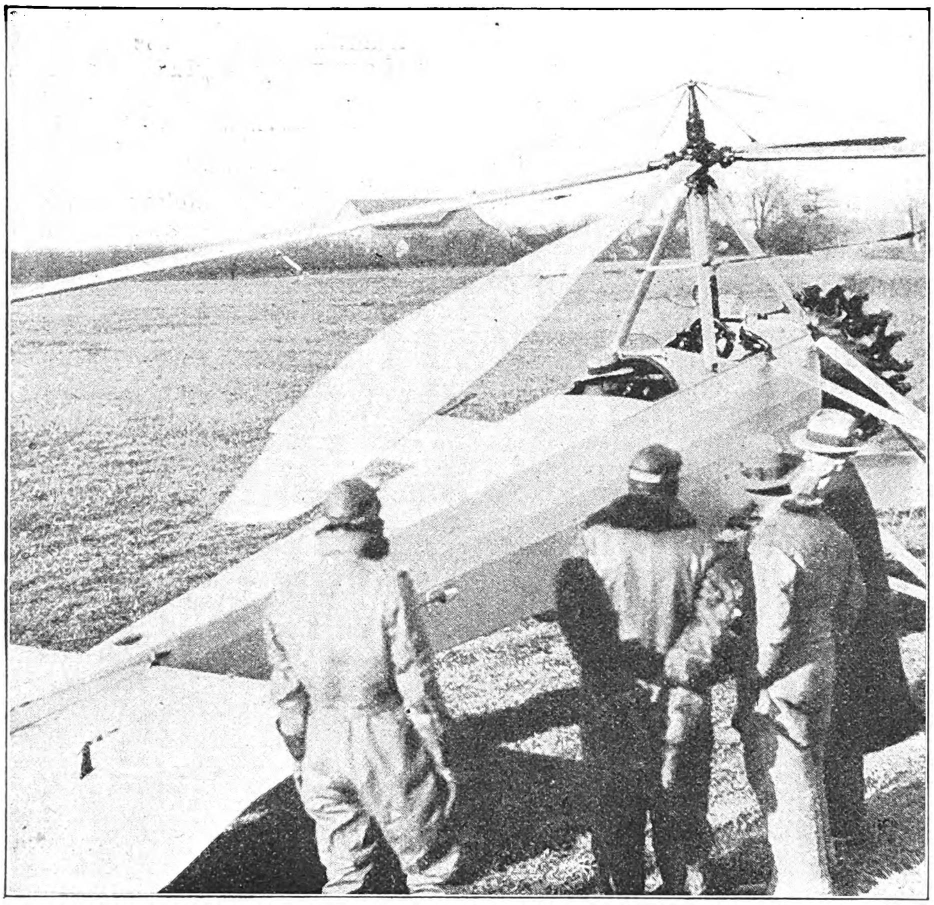
The autogiro which Harold Pitcairn demonstrated at Langley Field recently was brought over from England. The fuselage used is that of a two-seater Avro fitted with a Wright Whirlwind engine. Improvements are being incorporated in the autogiros at a rapid rate, and, in later models, the fuselage has been shortened and it is possible to start the rotor turning by pulling back the control stick, thus throwing the slipstream up against the rotor blades. In Pitcairn's machine, it is necessary to taxi around the field at a slow rate until the rotor starts turning at a sufficient rate to allow a take-off. This is a delicate proposition, for until they get going fast, a bump while taxying will tend to break the cables supporting the blades. Also, the blades get a rough motion and it is necessary for the machine to be stopped before the take-off in order to let them smooth out. About three quarters of a mile of slow taxying is required before the rotors gain their required 90 r.p.m. (There is a tachometer on the rotor.) Judging by eye, which is a hard thing to do, the take off with one person is about equivalent to that of a good OX biplane with two. The forward speed, however, is slower and although the rate of climb is not rapid, the angle of climb is probably better than that of an ordinary OX plane with an equal load. It is figured that the autogiro is about as inefficient at these low speeds as an airplane would be which had the same plan form. Especially in planes of low wing loading, that is of low landing speeds, the efficiency drops off very rapidly as the aspect ratio is decreased. At higher speeds, this does not make so much difference in efficiency and it is claimed that the autogiro becomes very efficient theoretically at high speeds.

THE best angle of climb seems to be achieved at about 45 miles per hour and the best rate of climb at about 60 miles per hour. The slowest speed at which Pitcairn's machine can



LOOKING UP AT THE AUTOGIRO

Piloting a ship of this type is a novel experience for one accustomed to ordinary airplanes. At the point where an airplane would stall, the "flying windmill" merely settles evenly



THE VANES ARE HELD BY CABLES

Wires from the vanes to the top of a short mast hold the blades up and prevent them fouling the fuselage or stabilizers when starting. Note the universal joints placed near the mast

fly level is about 30 miles per hour. Unlike the airplane, there is no danger in flying the autogiro at this low speed; if the speed is reduced too much, the machine merely settles. If on a take-off it is found that an obstruction will not be cleared, the pilot, that is, one who has been flying autogiros and not airplanes, merely cuts the gun, pulls back the stick and waits for the machine to settle. The high speed of the autogiro demonstrated at Langley Field was about 90 miles per hour. This, however, was not at full throttle.

As the speed increases, the up and down movement of the blades increases and, in the present model, the blades would hit the horizontal stabilizer were they allowed any more downward motion. Were this not the case, it is claimed that the present machine would do 110 miles per hour. This would give a better speed range than is obtained in ordinary airplanes. It must also be remembered that the present autogiro is rather a crude contraption and little attempt has been made to streamline many of its parts.

THE autogiro controls handle in much the same way as those of an ordinary airplane. Banking is necessary on turns as the rotor is equally efficient when traveling in any direction and would skid indefinitely. The ailerons and tail surfaces remain partially effective even though the machine is in a practically vertical descent. The down-wash from the rotor is such that streamers attached to the stub wings go back horizontally showing that the stub wings do not reach the stalling angle. Although the machine can descend practically vertically, a forward speed of 25 or 30 miles per hour is usually maintained. The maximum gliding angle is about half that of an ordinary airplane—in other words, somewhere between four and five to one. This restricts the choice of landing grounds but, on the other hand, it is possible to land in a smaller area.

The descent is a combination of a glide and a settling motion. When the plane comes within 15 or 20 feet of the ground, the stick is pulled back sharply. The tail skid hits first and the machine settles about two feet until the shock absorbers come into action. These have a play of about 15 inches and it is expected to increase this to 24 inches. The maximum rate of settling in a vertical drop is figured at about 16 feet per second, approximately the same speed as that of a parachute, and this should require about 18 inches of shock absorber travel. The landing very much resembles that of a bird. In the Langley Field demonstration, the usual run was about 40 feet in practically still air and with shock absorbers which did not allow a vertical landing.

It is hard for one accustomed to think along airplane lines to adjust his mind on the autogiro. As pointed out in the opening of this article, the rotor needs practically no forward motion to keep it turning, in fact, it is very evident that in descent, the turning speed of the rotor increases. Structurally, too, the airplane and autogiro are entirely different. The fuselage of an airplane is supported through its wings, which are cantilever structures, whereas the fuselage of the autogiro is supported through members in tension. These differences are of great importance and value.

AT first glance, one is strongly prejudiced against the autogiro because a rotating windmill does not look as if it were a sound piece of mechanism for the support of a heavy structure. It looks clumsy and foolish in the air beside an airplane. It is also inefficient at low speeds. On the other hand, it can fly slowly with no danger of stalling and it can descend practically vertically.

From 50 to 85 percent of airplane accidents are blamed on bad piloting. This is another way of saying that piloting requires too great skill and practise. The autogiro is essentially easier to fly than an airplane. It cannot be stalled or spun. There is no difficulty about overshooting a field. The angle descent is so steep that this requires no delicate judgment nor estimating of distance. If there is a crash, it will be at such slow speeds that little damage is likely to occur. Due to its ability to fly slowly without danger, the autogiro can be flown in much thicker weather than an airplane.

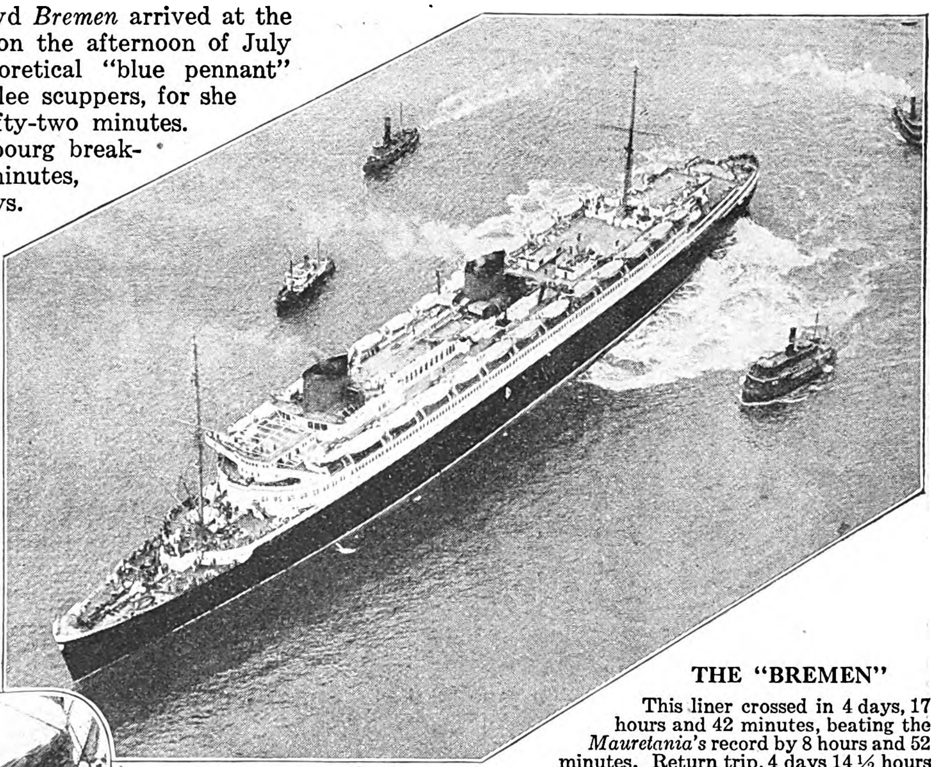
To those who have become accustomed to flying airplanes, their first flight in an autogiro is apt to be a little startling. When the autogiro is throttled back and the machine apparently stops in the air, it is hard to realize that this is a normal and safe procedure and not a stunt requiring great skill. We have become so accustomed to the necessity of landing fast and of judging height accurately that it is hard to visulize how much easier it would be to fly and how many more people would undertake it if these two elements could be eliminated. The autogiro has set new standards of performance which are bound to stimulate flying.

¶ *AFTER Mr. Osborn, contributing editor of our contemporary* Aviation, *flew in an autogiro and wrote the illuminating article which we reprint above, Harold F. Pitcairn, of the Pitcairn-Cierva Autogiro Company, took occasion, in a letter to Mr. Osborn, to amend and amplify several of the statements made. In order to present all sides, we are printing Mr. Pitcairn's letter in our "Learning to Use Our Wings" department.*—The Editor.

The New Queen of the Sea

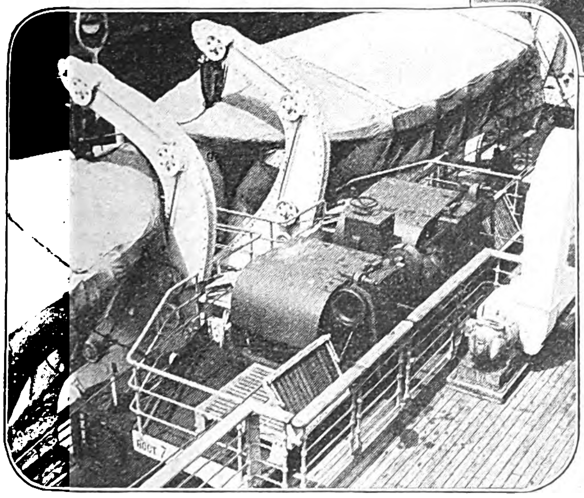
WHEN the North German Lloyd *Bremen* arrived at the Ambrose Channel lightship on the afternoon of July 22nd, down went the theoretical "blue pennant" of the *Mauretania* into the lee scuppers, for she had been beaten by eight hours and fifty-two minutes. The time of the new vessel from Cherbourg breakwater was 4 days, 17 hours and 42 minutes, thus docking passengers within five days.

The *Bremen* is 938 feet long, 98 feet wide (beam) and is a 50,000 ton vessel. The most extraordinary features are the two squat streamline funnels shaped like the cross section of a raindrop. She is an oil burner using 830 tons of oil a day, the steam pressure being applied to the four geared turbines. The smoke is carried up the sides of the boat in chambers to the stacks, thus making immense public rooms feasible. Every known safety device is provided and the arrangements for the comfort of the passengers are unsurpassed. The *Bremen* is a challenge to the other steamship lines and they are already busy at the drawing board.



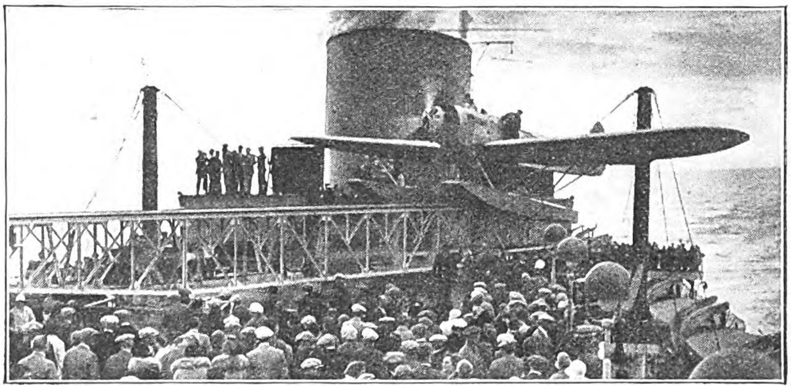
THE "BREMEN"

This liner crossed in 4 days, 17 hours and 42 minutes, beating the *Mauretania's* record by 8 hours and 52 minutes. Return trip, 4 days 14½ hours



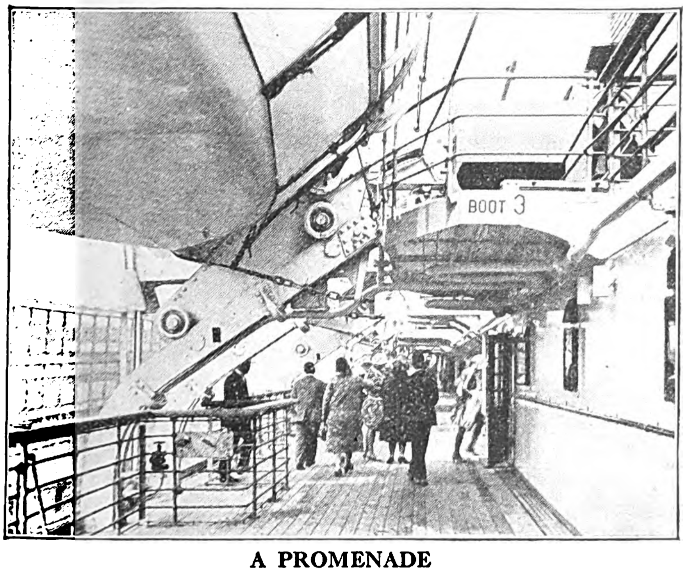
BOAT-LAUNCHING GEAR

The massive boat-launching devices will operate even if the ship is disabled and is listing badly



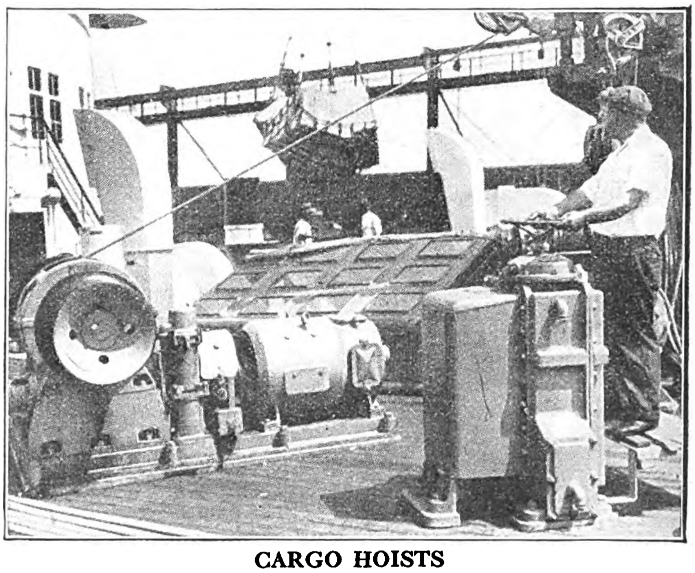
AIRPLANE CATAPULT

The airplane catapult on the upper deck enables mail to be sent from the ship 500 miles at sea, saving valuable time—New York to Berlin in 5½ days



A PROMENADE

The boat-launching gear is so arranged that the boats do not interfere with the passengers. Safety is a feature of the *Bremen*



CARGO HOISTS

While cargo is subsidiary to the passenger trade, it is speedily handled by electric winches. There are many motors on board

Monkey-Shines

A Naturalist's Account of Everyday Monkey Life at Home in the Dense Hot South American Jungles

By PAUL GRISWOLD HOWES
Curator of Natural History, The Bruce Museum of Greenwich, Connecticut
Photographs by the Author

IN THE JUNGLE OF BRITISH GUIANA

A typical scene in the country of the monkeys, inhabited by spider monkeys, Beesas, Sakis, and Red Howlers. There are no anthropoid apes in the western hemisphere; only monkeys

THERE had been a continued tapping sound for some time in the forest just ahead, a strange noise as if someone were flinging down missles from the high avenues of the jungle world. Now in a shower, again not so concentrated, the missiles pattered down through the leaves to the spongy floor of the forest where all further sound was engulfed in a humid embrace.

Stealthily I picked my way ahead, under the lowest growth, selecting each spot for my feet, where no twigs, snapping as I progressed, would announce my presence to the extremely acute ears of whatever jungle creatures I was about to see. In fifteen minutes I had reached a spot so close to the bombardment from above that I could see the leaves jump as each missile dropped through them from an unknown source.

The trees were gigantic, smooth-barked things, reaching almost into the skies, it seemed, and carrying a thousand parasitic plants upon their branches that trailed hundreds of lianas and bush ropes to the forest floor. Weight, great weight, had accumulated in their struggling arms; the perpetual dampness, the heat and the wind-blown spores, and the bird-carried seeds of parasites had accomplished their work; and now after years of playing host to these parasites they had found it necessary to throw out gnarled and rippling buttresses in every direction to support the unnatural heaviness which they felt.

The missiles continued to fall and tap the leaves. No sound disturbed the air save the call of the "gold bird" and the falling nut shells. The forest was strangely silent. Then from the emerald world above I heard the strangest, most blood-chilling cry in all the New World jungle.

Looking up, I saw a troupe of red howling monkeys directly above, in the highest branches. They had stopped their feast and bombardment of nut shells, and the great golden-red leader of the band had commenced that awe-inspiring chorus for which these animals are justly famous. He stood upon a thick limb, upon all fours, tail out and curled about a smaller limb, head down and eyes glaring directly at me, although I knew he had not seen a single move in the forest below. His lips rolled back over frightfully stained teeth, and from his throat issued a series of ghastly belches. Then from a low growl, the voice rose and rose and its power increased to the volume of a lion's voice at its best. The younger males now came in, one by one, until the whole troupe, as if in a frenzy of rage and challenge, rent the jungle with their fearful music. The chant rose and fell, rose and fell, and finally died out, leaving the listener with a sensation of sudden and awful silence.

IN the howler troupe were females with babies. One clung to its mother's breasts like a little human thing of the tree-tops. The mother would hold it in tight to her, pressing it back of the neck with her big but tender hand. Two larger youngsters played about in their lofty home, running back and forth upon the smallest limbs, unconcerned at the dizzy height.

The great bull leader of the band must have been very heavy. He stood as high as an ordinary table, and his long hairy red arms stretched out another two feet above his head. The fur of his back was the same wonderful golden-red as his arms. It ran all the way around his black ugly face and formed a pointed beard over his great swollen throat, where is situated the sounding box that produces the remarkable roars for which these monkeys are famous.

The soles of the howler's hands and feet are of course bare, and it is an interesting fact that a portion of the tail on the under side is also bare and heavily padded with skin, for use as an extra hand in progressing among the branches.

One of the most inspiring things in

the South American forests is the roaring of the howler monkeys during the dead of night, especially when rival bands are challenging each other. To the ears of the novice it bears all the horror and frightfulness that a perfectly good jungle should have, but to the experienced explorer, it simply means "howlers" and one of the most interesting animals of the forest.

Howlers are possessed of a strange instinct which causes the other members of a troupe to try to kill a wounded or disabled member. At Camaria, on the Cuyuni River in British Guiana, I witnessed this strange habit. We had been hunting along a road which had been chopped out of the solid jungle.

IN a tall tree bearing a fruit with an inky juice, a troupe of howlers and a number of smaller monkeys were feeding. One of our party wounded a howler, who let out a roar of pain and sat motionless where it had been struck. At first the others had been too frightened to do anything but dash for safety, but at the second cry of pain from their wounded member, two males turned back and with a savage rush attacked the wounded monkey. They tore into him with all the pitiless savagery and heartlessness that is characteristic of jungle dwellers. They roared and scuffled and bit, and the wounded monkey shrieked in agony. The sun shone down on three fiery bodies motivated by who knows what, to do this thing, undisturbed by the presence of man, their most deadly enemy. We put a stop to it all with our rifles.

To observe the smaller Saki monkeys, I constructed blinds in suitable places. Fruit trees in bearing are the surest lure for monkeys, and a blind situated below or near one of these trees is a likely place for the student of animal life. Monkeys will soon find it.

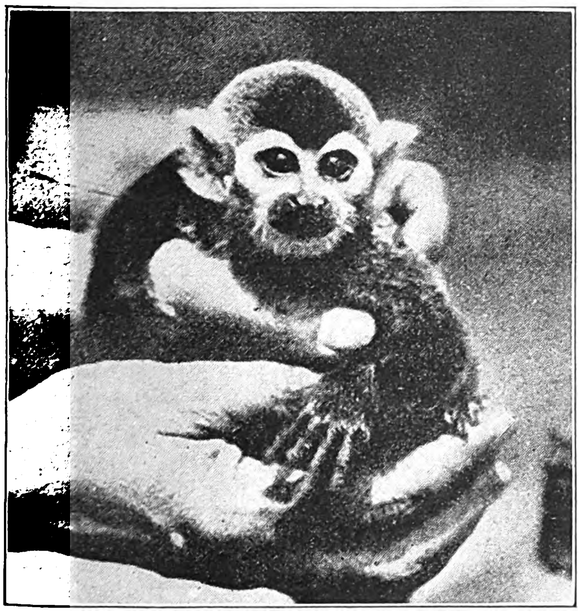
OLD MALE BEESA MONKEY

Small wonder that the myth of the "old man of the forest" took root among the Indians and refused to die

It is certainly true that to a certain extent, monkeys travel over accustomed avenues. It is only natural that animals as cunning as these are should see to it that the avenue of escape is a good one. I noticed that, in coming to a certain fruit tree, the Sakis almost invariably approached from a certain direction. Moreover, they undoubtedly followed a certain course, because certain limbs and lianas were used time and time again.

From my blind, by keeping extremely quiet, I could watch all their actions. I found the Sakis in the wild, not unlike the Sakis in the zoo. Their actions and pranks were endless.

The troupes talked continually in curious little whines, and these soft words were apparently used more in keeping the troupe together than anything else. Chatter and louder words were used only in squabbles or at the sight of something pleasing or displeasing. The clatter of a large troupe of advancing Sakis is unmistakable, for they throw down an endless barrage of discarded things.



A PET SAKI MONKEY

He was taken when very young, and supplied valuable information concerning the food of his own species

As an experiment in the avenue theory, I tried various methods of frightening the troupes away. My first experiment was to produce an unusual, but not too startling noise, and this I did with my voice, imitating the soft whinny of a horse.

At the instant of the sound every monkey froze in his tracks, looking wild-eyed and bewildered. I repeated the noise with the same result. No one seemed to recognize it or know what to do about it. A third trial brought results. Some member of the troupe coughed out a single note and in an instant every member had turned about and the whole crowd retreated rapidly but in orderly fashion into the forest, taking the well known avenues over which they had come.

The second experiment was equally interesting. I imitated the loud barks of a dog when a troupe was quietly feeding almost over my blind. In this case there was no hesitation or delay until the sound was heard again. The monkeys immediately beat a more or less panicky retreat, and I wondered if they really knew that the bark of a dog usually means men.

The third experiment was to frighten the monkeys violently by discharging my gun. This always threw the troupes into complete panic followed by a mad dash into the forest, and while an occasional individual would give a wild leap for the nearest branch, or tumble down through the foliage for a few feet before catching hold of something again, most of the monkeys even in their mad haste would follow the recognized route as closely as possible.

There are no apes in South America and whether these smaller monkeys of our American jungles possess intelligence or not, is not an easy matter to decide. It would seem to the writer that they do to a certain limited extent, as the following instances will show.

A BLACK Capauchin female monkey with her tiny baby were discovered in the top of a tall tree. This tree had come into heavy bearing recently and was a splendid one near which to observe all kinds of jungle folk who came to it in response to the sweet pungent odor that it cast over the surrounding forest.

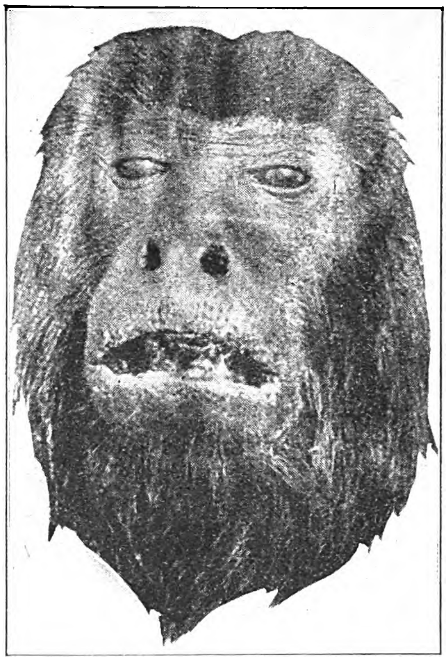
Mother was a sleek fat lady, hungry but lazy. Well, she had a perfectly good baby, so why not make use of him? Apparently she felt that she had sacrificed plenty in order to bring this child into the world and now he could make a sacrifice or two for her. Most of the fruit was borne upon delicate stems near the tips of the branches. Mother would venture as far as she dared, eating what she could reach and when a branch would bend considerably under her weight, she would put her baby down on the limb. Detaching him from her, she would urge him out after the delicate morsels of fruit. The little fellow would pick the fruit

side now cross the living bridge and when the last has gone across, the first monkey upon the far side of the stream lets go and the whole ladder swoops across the stream and crashes into the branches and foliage on the other side.

SUCH is the story of the monkey ladder. As to its possibility, the reader will have to form his own opinion.

Monkeys are pathetic little actors when in trouble. If their misery comes at the hands of man, they seem to feel the pain even more acutely, as though their torment came from the hands of a big brother. In sickness they become very quiet and disheartened. If in captivity, they look wistfully out through the wire or bars, as if a vision of the green sunlit jungle, with its free wild life and its good things to eat, was ever before their eyes. They brood, bow their heads, and bring pity into the hardest hearts; for, after all, they are more like us than any other creatures on earth today. No one who has studied them closely, either at home in the forest or as pets in civilization, can doubt what happened at that last branching of the tree of life.

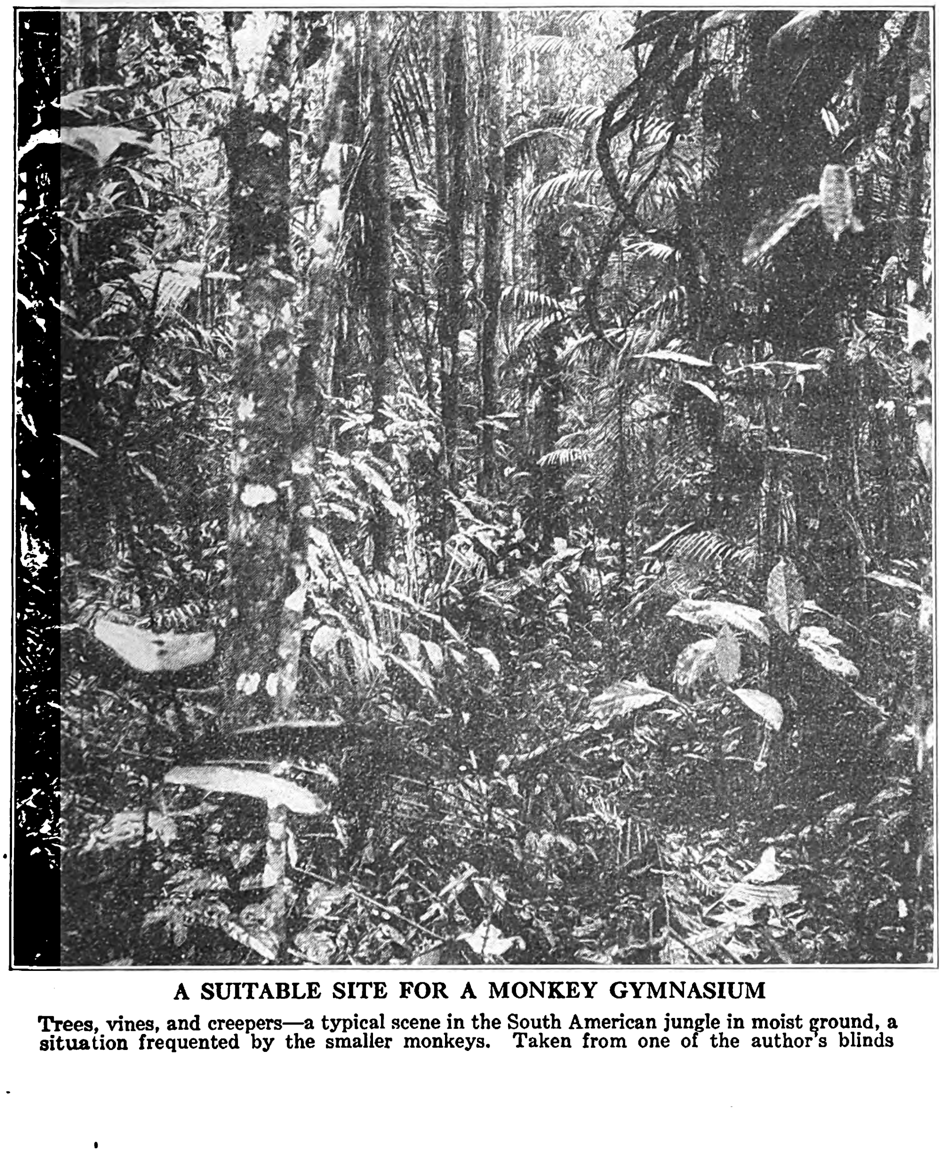
If such a doubt is still entertained by anyone who has only seen the later stages of monkey life, let him see the embryo of one of these fellow creatures. There will be no doubt then. Except for the long tail it is an unborn human being in every detail. Beyond the sacrum in man, at the end of the vertebral column, are four rather consolidated vertebrae called the coccyx. These bones are the vestiges of a tail, and when we remember this fact and what I have just said about the embryos of the animals, we realize how infinitesimal must be the chromosomal difference that makes one embryo a human being and one a monkey.



Courtesy New York Zoological Society

DEATH MASK OF HOWLER

The fur and beard are a beautiful golden red, the face black, and the teeth horribly stained from the juices of jungle fruits. The specimen was shot in British Guiana



A SUITABLE SITE FOR A MONKEY GYMNASIUM

Trees, vines, and creepers—a typical scene in the South American jungle in moist ground, a situation frequented by the smaller monkeys. Taken from one of the author's blinds

Down in the jungle of Columbia, along the tepid, yellow Magdalena, our party was hunting birds for the American Museum of Natural History. The old, stern-wheel steamer had put into a village and had refueled with log wood, and now her irate captain was blowing his whistle for us not to delay him any longer. He was a good fellow at heart, and in reality the delay of the steamer worried him less than the probability of losing us as companions. He was intensely interested in our daily bags and he did not want to miss the joy of seeing and handling all those brightly colored birds.

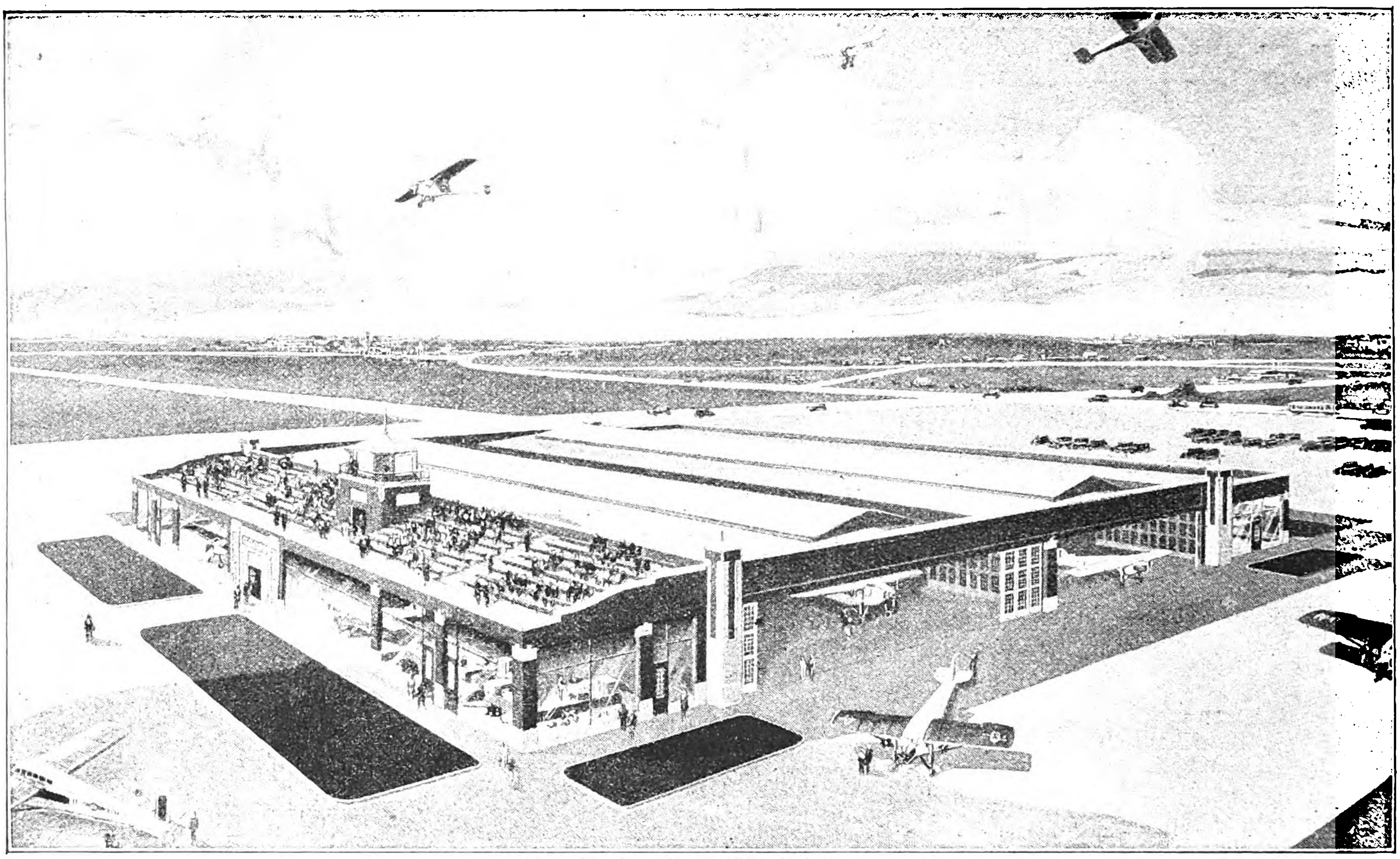
Collecting was exceptionally good and we were taking our time. High up in a ceiba tree one of the party saw something moving that resembled a squirrel, but in a minute it had hidden itself among the heavy foliage. We wanted squirrels for the collection and so a shot rang out and a small body went down, spinning as it fell into the undergrowth.

Laboriously we cut our way in with our bush knives, and then stopped short in horror, realizing our blunder. It was not a squirrel, but a tiny marmoset that faced us, brave beyond words in the face of death and these clumsy giants. Worse yet, a trickle of deep red blood rolled down the tiny thing's breast, where it had clasped a green leaf to the agonizing hole in its tender flesh. Its large eyes looked up at our towering bodies, asking dumbly for mercy, its little face full of despair and agony, but not a trace of hatred.

Never had any men felt so low or so miserably unworthy. It stared and stared, and no one could do anything but stare back, something tearing at our hearts and no one able to deliver a *coup de grace.*

AT last the little hand relaxed and the stained leaf fell to the ground. Those big bright eyes closed slowly as in sleep, but forever. A tragedy had occurred in the jungle, a tragedy momentous to three human beings, for a tiny, trusting brother had gone west through our blunder.

¶ *A beam of light and a photoelectric cell constitute the main elements of a new balance scale that is being used to determine the weight of paper in the process of fabrication. This scale gives the machine operator facts that heretofore were unattainable. A description of it will be published soon.*—The Editor.



A HANGAR FOR AN UP-TO-DATE AIRPORT

A grand-stand structure in conjunction with a modern hangar with long spans. Air races, air circuses, and even everyday aeronautical activity find eager throngs at every airport. Proper seating facilities to accommodate large numbers provide an additional source of income

How Shall We Design Our Airports?

"Landing Fields" No Longer Suffice; Complete Airports With Every Possible Facility Must Be Designed and Built

By WILLIAM E. ARTHUR*

WITH aviation in so early a stage of the formative period, it is not possible that there could be unanimous agreement upon all its problems, for most of them are of an experimental nature. However, there is unanimous agreement among the leaders of the aviation industry as to the importance of proper airports. All will admit that the ports have not kept pace with the technical advances of aircraft.

The airport is the link between air and land transportation. It is there, even more than in the air at the present time, that the success of aviation will be determined. It is there that the confidence of the prospective air passenger is built up. Adequate terminals are in some ways more important to the emerging aviation industry than to the long established railroad industry.

Although the greatest growth of commercial aviation in this country dates back only to the recent transatlantic flights, more than 1500 airports are in operation, and the number will probably be greater than 2500 by the close of this year. The country is overlaid by a network of airlines from coast to coast, and every community, in order to stay on the map, is faced with the literal necessity of establishing an airport. The race to establish airports is similar to that between alert communities to get on some railroad or another half a century ago.

THE earliest method of establishing an airport was for a community to set aside a level piece of land and call it an airport. Some of these fields were satisfactory as long as flying was done by light ships in fair weather. But the advent of heavy transport ships of five tons and more, flying on schedule winter and summer almost regardless of weather, quickly rendered such fields obsolete.

A fair picture of the airport situation throughout the country is contained in the experience of the Transcontinental Air Transport, preparatory to linking New York and San Francisco with a two-day air-rail passenger service. So great an obstacle was the matter of air terminals and landing fields that the company was filled with dismay. A year was required to make the airports on the two air jumps adequate for large transport planes.

One of the reasons for the tardy development of airports equipped to accommodate present-day transport operations has been that in most communities there simply has been no one with sufficient knowledge of the technical problems to lead the way. Another obstacle is typified by the experience at Croyden Field, London, England, where a 600,000-dollar investment had to be scrapped simply through obsolescence and 1,000,000 dollars additional spent to bring the field up to modern requirements.

But these obstacles need no longer stand in the way. Over the past few years there has accumulated a tested and proved supply of engineering knowledge in relation to airport design and construction, which is adequate for the problems of any community and anticipates the advances in aviation for a good many years to come.

---

*Manager, Airport Division, The Austin Company, Cleveland, Ohio.

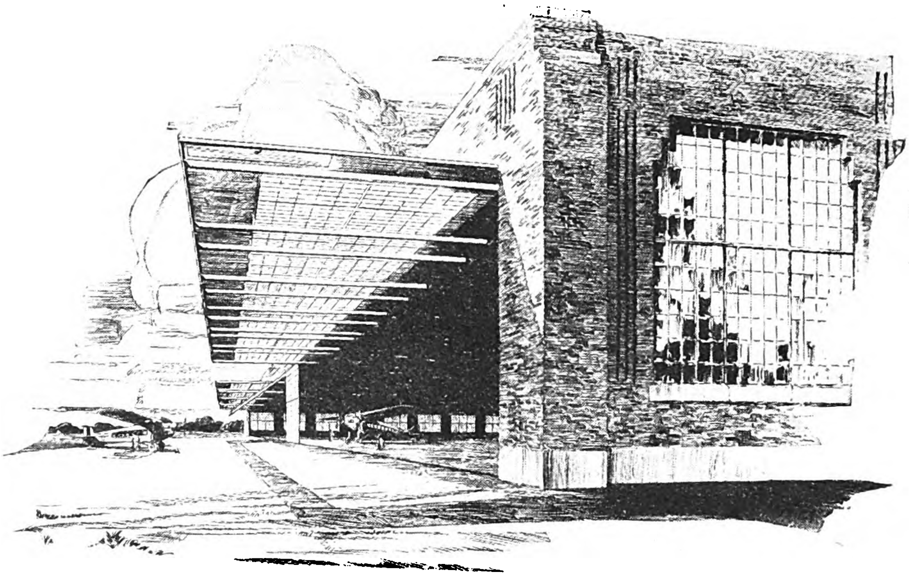
The greatest immediate problem facing the entire aviation industry is that of increasing revenue, and that problem should be given careful consideration in planning any airport.

One thing that is not sufficiently well known is that a properly located and designed airport can usually be placed on a self-sustaining basis. In time, it can be made to show an actual operating profit, if administered by a capable airport manager unhampered by selfish political influences.

Nearly every airport has a large number of possible sources of profit in addition to the customary leasing of space to airline operators, flying schools, aircraft factories, and accessory maufacturers for hangars and other buildings. Much income can be gained from various concessions which can be established at the port. For example, restaurants, refreshment stands, cigar stores, barber shops, news stands, and telegraph offices can be housed in the administration buildings and passenger depots. Grand stands and roof-garden restaurants for sight-seers are sources of revenue. A hotel and shops of various kinds can be incorporated in the building group. Facilities for the display and sale of aircraft can be included in the hangars and administration buildings.

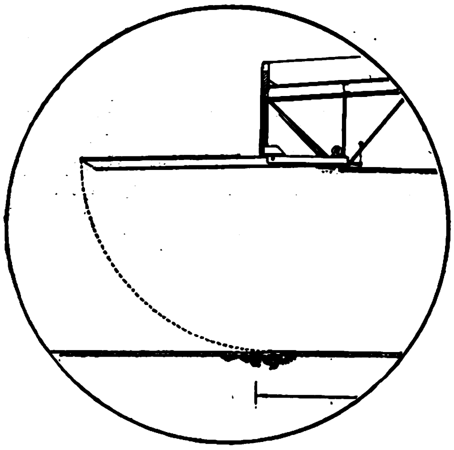
CHOOSING an airport site is a much more complicated and difficult procedure than merely selecting a level field. While a good airport must have a level field, all level fields do not make good airport sites. The most important step in the establishment of an airport is a preliminary survey.

Such a survey must cover a multitude of details. A few of these are the location of the port with respect to the city, highways, railroads, and street cars; meteorological conditions, such as flow of air currents; hazards and approaches; fog conditions and smoke haze; fire protection; parking areas, and the geographical advantages of the city for various airways which may be brought into the port. The preliminary study should take into consideration the proposed ultimate development over a period of years, and the plan should be elastic enough to allow for unforseen deviations from the original development program.



AT CLEVELAND AIRPORT

This recently completed hangar is of cantilever construction with cantilever door operation. One of the largest in the world, it has a 200-foot clear door opening which may be extended indefinitely, i.e., both side walls may be removed. A section of the door in the open position is shown at right



Before actual construction is started, a comprehensive plan of initial development should be worked out, including drainage, landing, and take-off areas, airplane traffic control, lighting and signals, automobile and pedestrian facilities, and the grouping of the buildings. The various drafts caused by roofs of buildings make the proper arrangement of hangars and other structures vital to safe flying.

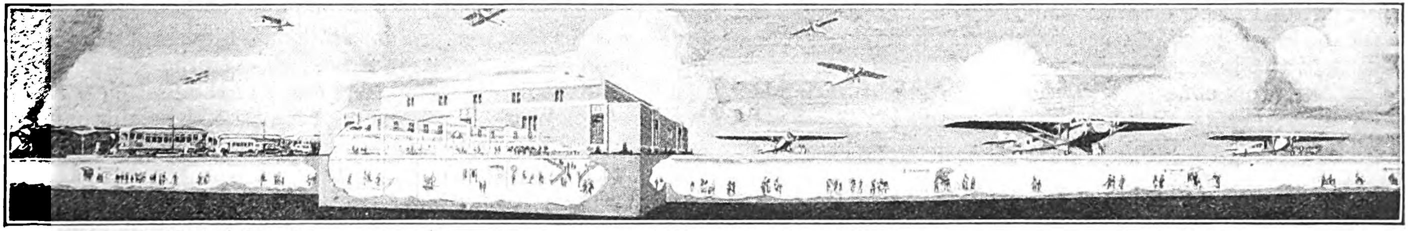
Large investments sometimes have failed to produce safe airports because soil research has not been linked with hydraulics in the drainage system. Too much of airport drainage has been guess work. The characteristics of the soil should be studied, before drainage is installed, to determine the rate at which it will absorb water. Soil treatment and drainage are especially vital in the "all-over" type of field.

Despite the fact that hard-surfaced runways have the disadvantage that only one runway can be used at a time, they are necessary where weather conditions at certain periods of the year render the field too soft for heavy planes. Runways should be so constructed that, should the pilot miss them because the airport is blanketed with snow, or for any other reason, he will not encounter ditches and similar hazardous, accident-causing obstacles.

There are numerous ways of treating runway surfaces, varying in cost and efficiency from merely grading, rolling, and seeding the surface to paving it with vitrified shale paving brick laid in a cement mortar bed on a heavy concrete base. Which to use depends on the original surface and the requirements of airplane traffic—and also the finances of the community.

A turf runway has a low first cost and a high maintenance cost. It requires time to establish and is easily damaged by tail skids, but produces minimum glare under flood lights. It is resilient, and a fair surface for wheel braking.

Brick, while having a high first cost, furnishes extremely long life with low maintenance cost. It is mudless, dustless, has good visibility, is a fair back-

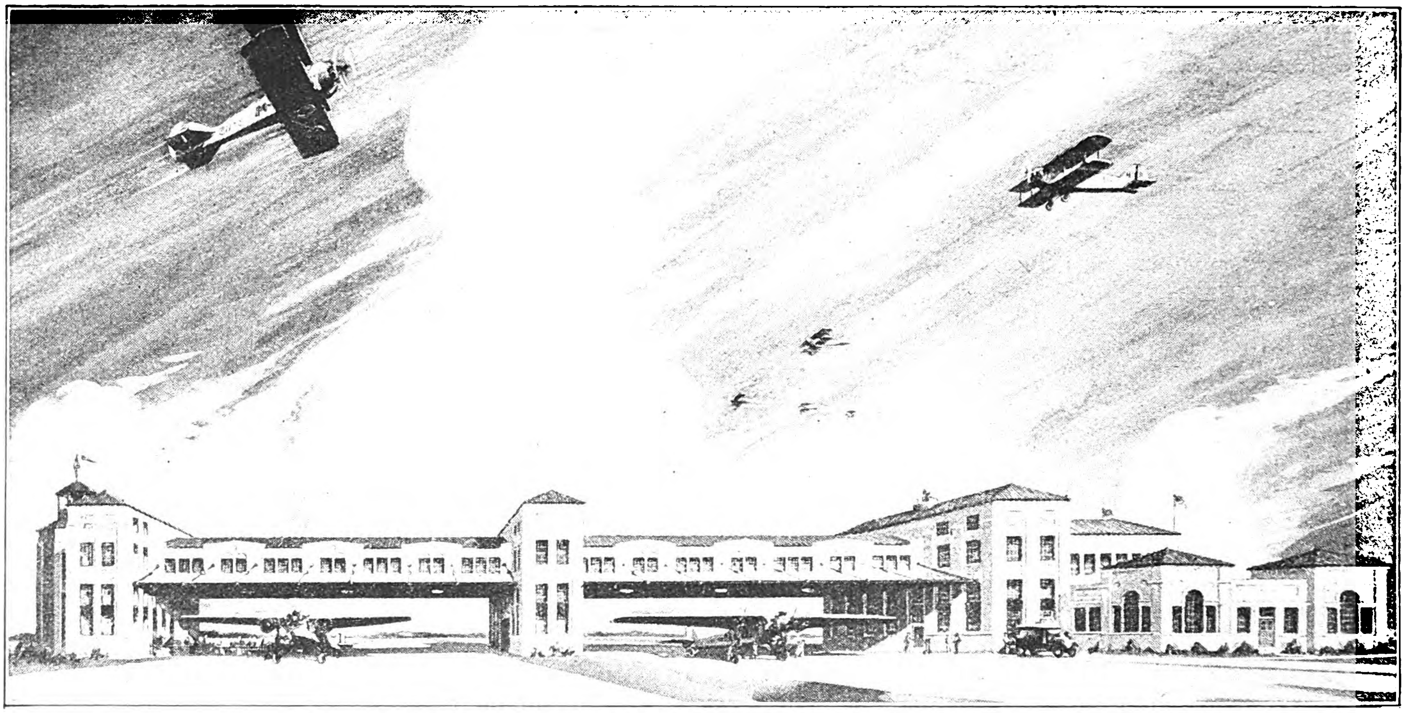


All illustrations courtesy The Austin Company

FOR THE SAFETY OF PASSENGERS

A substantial depot of pleasing design, with comfortable waiting room; also facilities and concessions for the convenience of the public.

Safety of passengers and protection from the weather is assured by an underground passage-way to loading runways and to the railroad



COMPLETE IN EVERY DETAIL: A UNIQUE DESIGN

Side elevation of a modern depot which provides maximum safety, comfort, and convenience. Airplanes taxi into position under the bridges for discharging or taking on passengers. These passengers can reach the loading point only through the bridges and down stairs

ground for markings, and is not damaged by tail skids.

Runways of rolled cinders and crushed stone or slag, while having some advantages, give off flying particles which damage wing fabric, motors, and propellers. Other methods of surfacing runways are with concrete, Tarvia re-tread, Tarvia penetration macadam, and sheet asphalt.

WITH the rapid progress that is being made in all branches of aviation, the design of hangars is advancing and must continue to advance. Airplanes are being designed which are larger than any now in use. In five or ten years, wing spreads of more than 100 feet probably will be common on non-stop transports flying from coast to coast. Therefore large clear spans are of paramount importance.

This is bringing into prominence the cantilever type of roof design, which permits enormous floor areas unobstructed by pillars and other supports. The cantilever type of roof also permits expansion, should the hangar have to be enlarged. Cantilever type doors also are coming into greater use. They are made in sections, each of which may be operated singly, or in conjunction with any or all of the other sections. The open cantilever door acts as a canopy in front of the hangar.

Cantilever roof construction and cantilever door operation are combined in a single building for the first time in a hangar which The Austin Company recently completed at the Cleveland Airport for lease to transport operators. The hangar is 120 feet deep with a 200-foot clear door opening, and has a 20-foot clearance under the trusses. The unobstructed floor area could accommodate a ship of 190-foot wing spread, which is three or four times as great as the spread of the average transport plane now in operation.

However, tubular steel sliding doors are perhaps the most popular doors now in use because of their simple operation, good appearance, fire-resisting qualities, and the amount of daylight they admit. There are a number of other types of doors, and a large number of considerations entering into the choice of the most efficient door for each hangar.

Hangar problems vary with each airport and each locality. Heating alone presents different problems in different sections of the country. The hangar problems of the transport operator differ from those of the aircraft manufacturer. In any airport, the hangars should be located so that the taxying of planes over long distances may be avoided.

One general objective should be aimed at in the grouping of buildings. That is the separation of factory buildings, hangars in which repair operations are carried on, flying schools, and military hangars from the administration building, passenger depot, and all structures engaged in purely transport business. Aside from convenience, there is a psychological reason for this. The sight of repair operations on planes, of military maneuvers and student flying is not an attractive sight for prospective passengers.

This grouping should be worked out in the preliminary plans for the port.

Aircraft manufacturing plants present problems new to industrial building. They necessitate designs permitting economical straight-line production, at the same time allowing the maximum amounts of daylight and clear floor space.

The aviation industry simply has been too busy with the multitude of other problems to have given much thought to passenger terminals. Yet adequate passenger facilities are needed to build up passenger traffic, for this offers the industry the most immediate and important channel for the increased revenue which is so imperative.

THE American public is receptive to the idea of air travel, provided it receives the encouragement it has a right to expect in the way of comfort and safety, in addition to time saved. The traveling public of this country is accustomed to, and insists on, a degree of comfort unknown to any other country or age. When aviation was in the novelty stage, a trip in a plane was regarded as an adventure, and hardships were cheerfully accepted as part of the game.

Air travel, however, is no longer a game. It is regarded by an increasingly large percentage of the traveling public with the same matter-of-fact attitude as railroad travel. In air travel, as in rail travel, the public is demanding not only comfortable waiting rooms and conveniences, but safety control of passenger traffic.

The psychology of the first class railroad terminal is one of inspiring confidence. This psychology would be even more desirable at the airport, where every first-time passenger is more or less nervous. Moreover, if a business man takes a plane to keep a business appointment in a distant city, he wants to feel comfortable and be presentable on arrival. He doesn't want to present himself with shoes muddy and clothes bedrabbled by rain from wading over a wet landing field to or from his plane. He doesn't want his nerves on edge from a narrow escape from death while hurrying across an unguarded runway.

The trouble is that, with few exceptions, all our airports are at present purely freight stations. The passengers are in much the same position as if they were required to scramble over the tracks at a freight yard to board a crack passenger train. This lack of terminal provision for air travelers is in striking contrast to the safety features and Pullman luxury of the newer types of passenger planes.

MOST transport lines feel—or have felt until quite recently—that passenger revenue does not as yet justify the expenditure of the large sums required to establish adéquate passenger facilities. I believe that they are reversing the normal order of the cart and the horse. The establishment of such facilities will bring about an increase in passenger business and the growth of revenue from that source. The large sums the transport lines are spending for improved passenger planes will avail them nothing if passengers are not attracted to the air terminals to board the planes.

The railroad terminal principle of handling passenger traffic has been adapted to airport conditions in plans which have attracted widespread interest throughout the country. In depots constructed according to these plans, passenger traffic, completely controlled, would pass from the street door through passenger concourses directly into the cabins of their planes without once leaving cover.

One type of air passenger depot under these plans could consist of several units, serving the purpose of piers for the support of spans of a covered concourse bridge. The space between the piers and beneath the span would form covered loading areas for the planes.

When the passenger alights from his cab under the marquee at the station entrance, he would enter a general waiting room, purchase his ticket, and ascend to the passenger concourse on the mezzanine level. When his plane was announced, he would descend one of the stairways built into the piers and walk through a railed-in passageway to the open door of the plane, directly to his seat. In a word, the passenger traffic will be controlled in much the same fashion as the loading of an ocean liner, where a gangplank makes entrance at prohibited points impossible.

AS planes taxi to and fro between the loading areas and the hangars, there would be no danger, as at the present type of airport, of hitting a visitor or passenger strolling across the taxiways. No one could gain access to the field except those having business there, any more than passengers at a modern railroad terminal may stroll along the tracks while waiting for their train.

A variation of this idea is to have the passenger concourses located in subways instead of overhead bridges. Both the subway and bridge idea could be combined in the same depot. The main idea is to keep the passengers comfortably sheltered and off the field.

Another problem which eventually must be met by the airport is the coordination of air transportation with other modes of transportation—railroads, street railways, motor busses, and steamers. The growth of air travel is already bringing about the convergence of other modes of land travel at the airport.

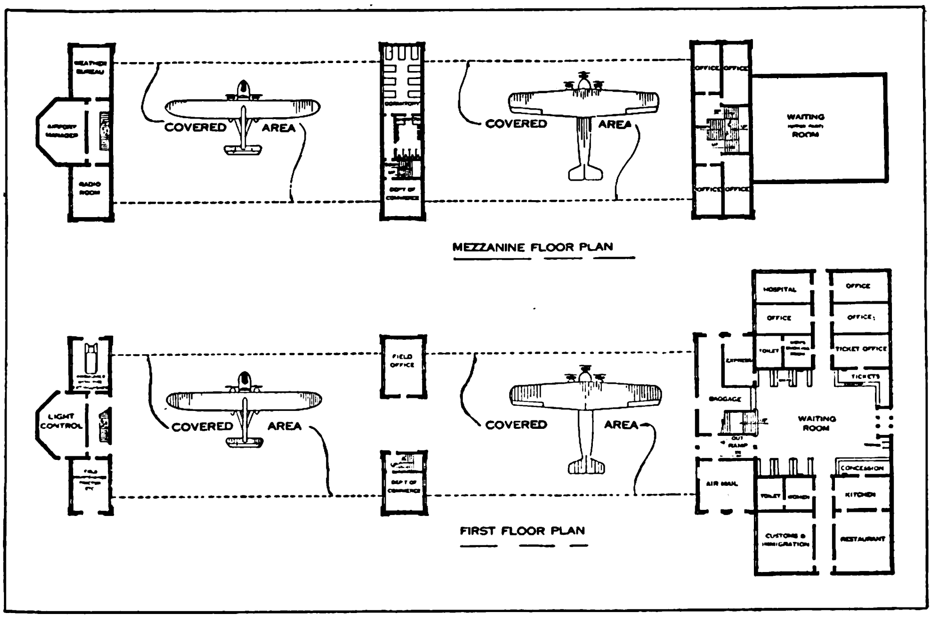
The rail vehicles may be brought in through subways, and the passengers may change from one mode of transportation to another by crossing over on concourse bridges from one section to another in the joint terminal. Or the rail vehicles may use the ground level and the passengers, underground concourses. These arrangements, of course, will depend in each case on local conditions.

As air travel increases in popularity, accessibility to the airport will be more and more sought by the public. This may result either in the city tending to grow out around the airport or the buying of land in the heart of the city for the establishment of separate passenger stations, leaving the locations on the outskirts for freight airports and garage and repair operations. The latter alternative depends a good deal on the development of the planes themselves. If the landing speed can be reduced from the present 40 to 60 miles an hour to 20 or 25 miles, and the distance of the take-off reduced by half, the passenger airport in the heart of the city would be more feasible because less area would be required.

THE industry has been experimenting with autogiros, helicopters, catapults, various braking devices, and other methods of accomplishing the reduction of landing and take-off distance, but it is safe to say that it will be a long time before they are commercial possibilities. When the time comes that smaller landing fields are required, the area at the present airports will all be needed for the additional hangars and other buildings necessitated by the increase in operations.

It is quite impossible to make any long-term predictions about an industry so new and energetic and filled with the pioneer spirit as is aviation, but for all practical purposes airport expansion and improvement need not be retarded through fear of too rapid obsolescence. No alert industry hesitates to replace equipment before it is worn out, if new equipment shows a net savings in output. If improvements at an airport produce large returns on the investment in developing the industry, aside from paying actual profits, they have well served their economic purpose, even though they become obsolete in a few years.

This article, of course, make no attempt at a detailed and exhaustive treatment of its subject, but simply aims to indicate in a general way some of the more salient facts in connection with what the writer considers to be at the present moment the most important phase of aviation. The subject will be a vital one for a good many years to come.



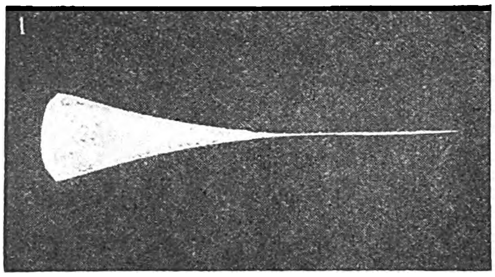
SUFFICIENT UNTO ITS PURPOSE

Plan of the depot shown on the opposite page. It will be noted that every conceivable convenience has been provided; also a hospital, customs bureau, radio room, et cetera

Razor Blade Science*

Why It Takes Only Five Seconds to Cut Your Whiskers Off

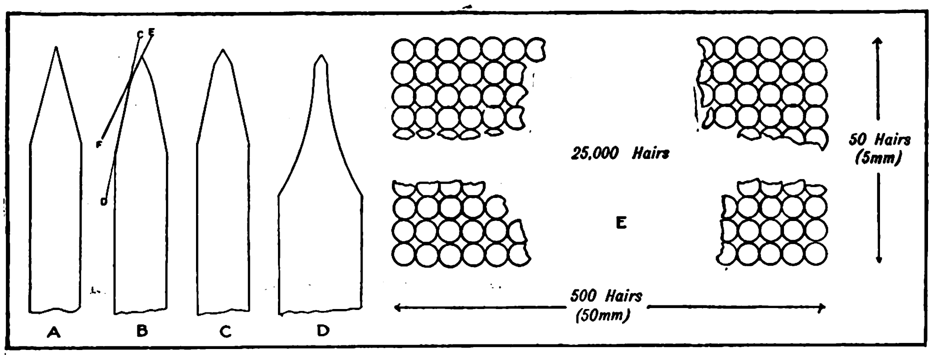
By J. FERDINAND KAYSER†
Member of the Association of Metallurgists (Great Britain)



One type of blade—hollow ground

DURING the last few years the present writer has examined and tested several hundred razor blades made both in this country and abroad, and, it is proposed to describe and illustrate the various types of cutting edges encountered and the *modus operandi* of wear. None of the blades examined were specially prepared, but were purchased from retailers. In every instance, at least 12 blades from one source, and of one and the same type were examined, and finally used for shaving purposes.

One type of safety razor blade is almost identical to a hollow-ground long razor, in-so-far as cross section and geometry of cutting edge are concerned. It is illustrated by photographs 1 and 2, at about 2¾ and 22 diameters respectively.



A, B, C, and D are the author's four classifications of cutting edges

The majority of safety razor blades are, however, manufactured from cold rolled strip and are ground and finished after being hardened and tempered. The thickness of the strip varies from six thousandths of an inch to twenty thousandths of an inch, according to the type of blade. Methods of producing the edge vary, but, whatever the exact process adopted, it can usually be roughly divided into the following three operations: Rough grinding by means of an emery wheel. Finish grinding by means of a very fine-grained emery wheel, or by means of hardened and polished steel wheels dressed with a preparation of stearine and chromium sesqui-oxide. A final stropping process.

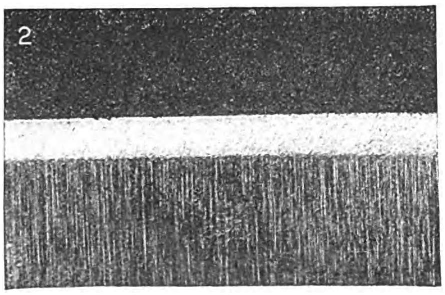
When examined at a very low power, say not more than 10 diameters, all safety razor blades appear to have a similar cutting edge, which, in the majority of cases, seems to be formed by the intersection of two plain flanks. A more detailed examination at various magnifications, from 15 to 400 diameters, shows, however, that cutting edges vary greatly, and it is possible to place them in one of four classes, which, generally speaking, remain sharply defined.

The simplest cutting edge is formed by the intersection of two plain flanks, as illustrated in the drawing, at A. The microscopic examination of blades with such a cutting edge presents no difficulties to even an unskilled microscopist. A typical example of a good edge of that type is illustrated in photographs 3, 4, and 5, at about 7, 22, and 148 diameters magnification respectively. The included angle of the cutting edge is usually about 18 degrees. All blades of this type have, however, by no means so perfect a cutting edge, and that is well illustrated by photographs 6 and 7, each of which has a magnification of about 37 diameters, and neither of which edge would give one shave.

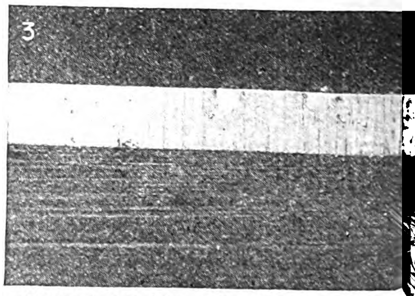
The majority of safety razor blades have a cross section of the type illustrated in the drawing B. Unless care is taken in mounting them for examination most fictitious results can be obtained at some magnifications. If a "cover slip" or a "prism" vertical illuminator is used and the blade is so mounted that the plane CD, in drawing B, is at right angles to the optical axis, an appearance similar to that shown in photograph 8—magnification about 37 diameters—is obtained. If, however, the blade be so inclined that the plane EF is at right angles to the optical axis, then only does one obtain a photograph of the true cutting edge, as illustrated in photograph 9—magnification about 37 diameters. Photographs 10, 11, 12 and 13 illustrate a good edge of this type at about 7, 22, 148 and 296 diameters respectively.

RAZOR blades with an edge as illustrated at C, in drawing, are more seldom encountered. A typical example is illustrated by photograph 14, at about 22 diameters magnification. The true nature of the cross section is, however, not obvious from that photograph, but is clearly shown by photograph 15, also at about 22 diameters magnification. Photograph 16 shows the extreme edge at a magnification of about 296 diameters. In this particular case, the actual cutting angle was approximately 18 degrees, while the two secondary flanks were inclined to one another at an angle of 10½ degrees. In spite of the rarity of this type of edge, the writer has found that it is always remarkably uniform, and the blades shave smoothly and have a reasonably long life.

The drawing D, illustrates a further type of edge, which is said to be "hollow-ground." While it is true that the secondary flanks are concave, the term "hollow-ground" is misapplied, as, in the razor trade, it is used to describe razors with cross sections similar to that illustrated in photograph 1. The blades with this type of edge, which were examined, proved to be far from uniform. That is well illustrated by photographs 17, 18, and 19, all at about 11 diameters magnification.



Immediate edge of hollow ground blade

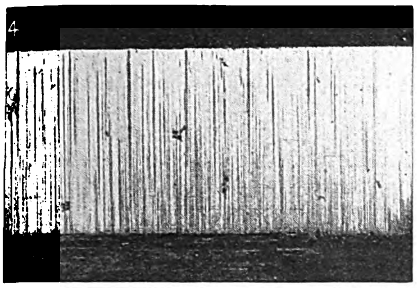


Typical cutting edge with plain flan

---

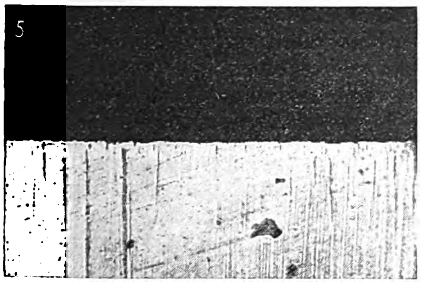
*Abstracted by permission, from *The Engineer* (London)

†See "Among Our Contributors," page 279



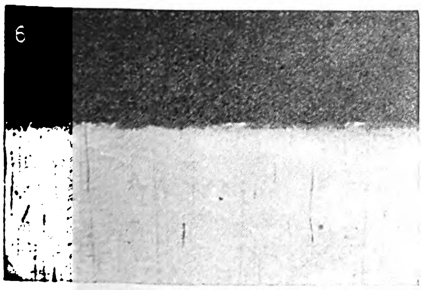
Same as 3, except more highly magnified

Before describing the *modus operandi* of the wear of safety blades, it is interesting to consider the work which each edge has to perform before being discarded or re-stropped. The average shaving area of a normal-sized man is of the nature of 40 square inches. The distribution of hair over that area varies in different individuals, and also in one and the same individual. A concentration of 645 hairs per square inch is, however, as high as is ever met with, that is a total of 25,000 hairs to be cut per shave. Assuming that individual hairs have a circular cross-section of approximately one 250th inch in diameter, and that 25,000 were packed together as illustrated in the drawing at E, the area of the cross-section they would occupy would amount to about four tenths of a square inch; say, a single big whisker about five eighths of an inch in diameter, not allowing for the voids as in E. After numerous observations of shaving times, and assuming a distribution of 645 hairs per square inch and a total length of cutting edge of two inches, the total time during which the edge is actually cutting through hairs has been found to be of the nature of five seconds.



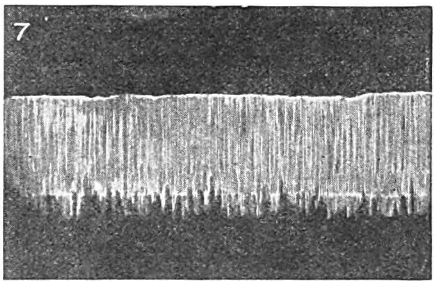
The same as in 4, magnified 148 diameters

The edge of a good blade does not on an average ever give more than ten clean shaves, and hence its useful cutting life is only 50 seconds. The rate at which a razor traverses the face is of the nature of from 20 to 40 feet per minute.

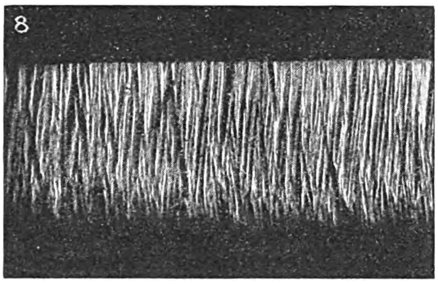


An example of type A (see drawing)

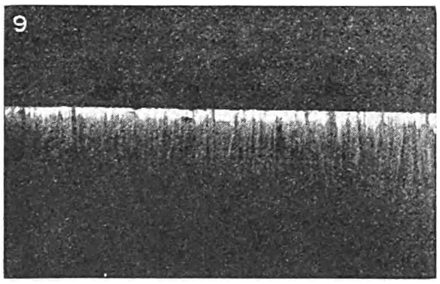
There are so many variables in shaving that the above figures must be used with caution, but for the present they are put forward as a concrete example of the approximate amount of "work" a razor edge is called upon to perform. In the majority of cases safety razor blades are discarded when blunted, but certain types can be stropped readily, and the edge continually renewed.



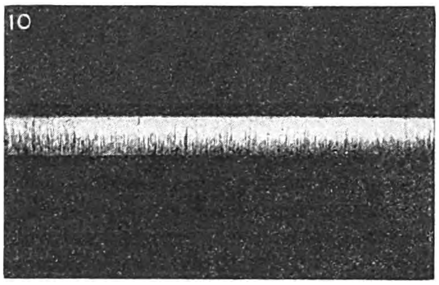
Not good, even for a single shave



Mounted with cutting edge out of focus



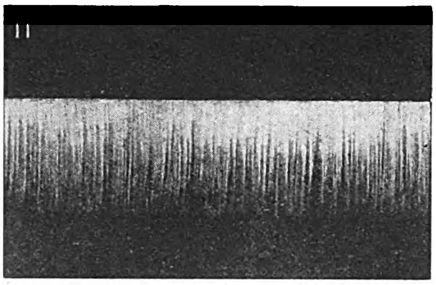
Mounted with cutting edge in focus



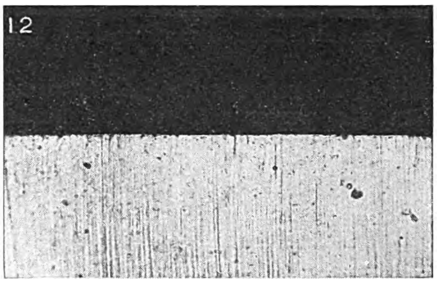
A good edge properly mounted

The majority of safety razor blades are made from straight carbon steel containing 1.1 to 1.3 percent carbon. One of the makes of blades examined was, however, made from a high alloy steel of the following approximate analysis: carbon 1.35 percent; silicon 0.8 percent; chromium 12.0 percent; molybdenum 1.0 percent; cobalt 1.1 percent.

The microstructure of the plain carbon steel blades consists essentially of globular cementite embedded in a structureless matrix. The size and distribution of the cementite globules varies greatly. A typical example of the structure of a good blade at about 296 diameters is shown in photograph 20. The edge there illustrated had been used five times and was still in good condition and gave a further five clean shaves. Photograph 21 at the same magnification illustrates the structure of another blade, which had to be discarded after two shaves. The structure in the above two cases was developed by etching in two percent nitric acid in alcohol for one minute.

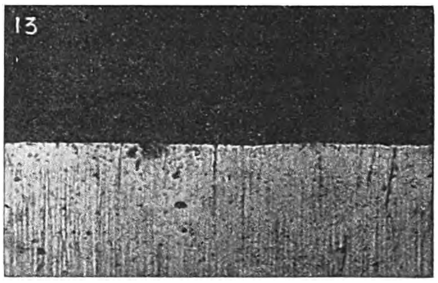


The same edge as in 10, magnified 22X



The same edge as in 12, magnified 148X

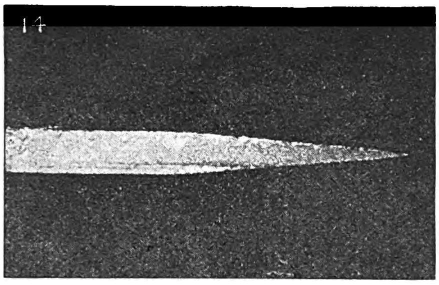
The blades made from the high chromium steel show a somewhat analagous structure, but the matrix appears to be sorbitic[1] and the non-etching carbide corresponding to the cementite of the straight carbon steel blades has not a pronounced globular structure, and is not as uniformly distributed as is the cementite in the carbon steel blades. A typical structure developed by etching in 10 percent nitric acid in alcohol for ten minutes is shown in photograph 22 at about 296 diameters. The particucular edge photographed had given approximately 15 shaves, but, then



The same edge as in 12, magnified 296X

---

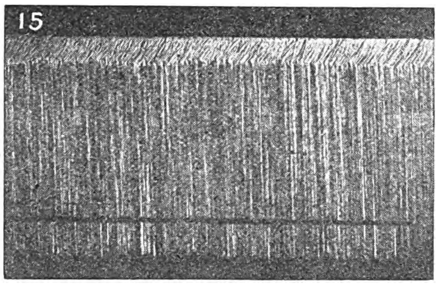
[1] "Cementite; Sorbite." Steel is not a simple, homogeneous substance like glass but is composed of grains and crystals of different constituents, of which the above are common examples. Cementite is iron carbide; the hardening qualities of steel are chiefly due to its presence. Sorbite confers tensile strength and toughness on the steel.—*The Editor.*



Third classification; like C in drawing

dragged badly, and was discarded.

The study of the wear of cutting edges is complicated by the fact that a blade which will no longer shave one individual may function quite satisfactorily when used by another with a beard of different texture. At one time, when the writer was testing blades made from chromium steel of the analsis previously mentioned, he found that, while he had to discard average blades after approximately 15 shaves, another person with a much stiffer beard could continue to shave with them for at least another 50 times.

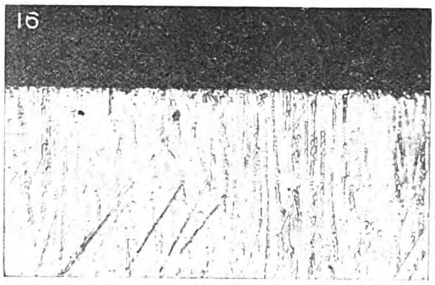


Same classification as shown above

Photograph 23 at about 296 diameters magnification illustrates a defect in a blade which had worn to such an extent that it was found to drag uncomfortably. Another part of the same edge, after etching in two percent nitric acid in alcohol, is illustrated in photograph 21, to which reference has been previously made. Although it is not very clear in the photograph, visual examination through the microscope showed that, in general, globules of cementite projected from the cutting edge exactly as described by Desch and Roberts,[2] who suggested that the property of keeping an edge depended upon the size and uniformity of distribution of the particles of cementite.

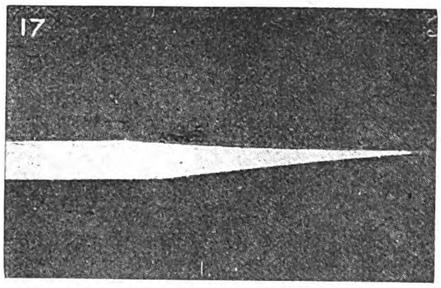
THERE is no direct evidence that the cementite globules in a properly hardened razor blade blank are sensibly harder than the matrix, and it is unlikely that the action of shaving would erode the latter and leave the cementite projecting from the edge. At least 50 percent of the blades examined were found to shave satisfactorily, and yet the size of the cementite globules and their distribution varied considerably, even in blades from the same source. Without exception, however, good safety razor blades exhibit a perfect edge at 400 diameters and have a Firth Diamond hardness of 650 to 800.

Wear never takes place uniformly along the edge. In the case of a good blade, one usually finds that the edge remains more or less perfect for the the first few shaves—see photograph 20—and then commences to break down in patches, such as are illustrated in photograph 23. Finally, the whole edge tends to disintegrate, leaving cementite globules projecting, and in some parts developing pits. Careful examination of many hundreds of blades has shown that the cutting edge of a normally hardened blade does not show the slightest tendency to become rounded or wavy. In fact the chief destroying agent seems to be corrosion.



Same as at left, except magnified 296X

The finish which the final stropping process gives to a cutting edge is such a perfect polish that corrosion can be resisted for a considerable time, but if once the edge becomes damaged, either while shaving or being dried, a small freshly fractured surface is exposed, from which corrosion might be expected to extend and produce the type of defect illustrated in photograph 23. That suggested explanation of the cause of failure is supported by the fact that if, instead of wiping a razor after use, it is kept in an anti-corrosion liquid, its life is usually at least doubled. It is also further supported by the fact that the chromium steel blades, previously mentioned, which are more or less stainless, give remarkably long lives.



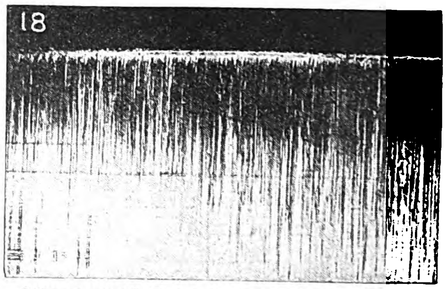
Fourth classification; like D in drawing

The chromium steel blades wear differently from a carbon steel blade, in that, in those examined, the carbide particles have not been found to project from the cutting edge, but rather appear to have fallen out. Whatever the exact *modus operandi* of wear, the mechanical result is, nevertheless, the same, whatever the composition of the steel, and the question as to whether a properly hardened blade will shave depends partly upon the geometry and condition of its cutting edge and partly upon the texture of beard to which it is applied.

WHILE numerous good blades are procurable, it is obvious that many manufacturers do not control their product microscopically, otherwise blades similar to those illustrated in photographs 6, 7, 17, 18, and 19 would never be allowed to leave the works. A magnification of from 15 to 30 diameters already shows a very great deal, and it should not be impossible, even in factories producing hundreds of thousands of blades per week, to examine a considerable percentage at some such magnification.

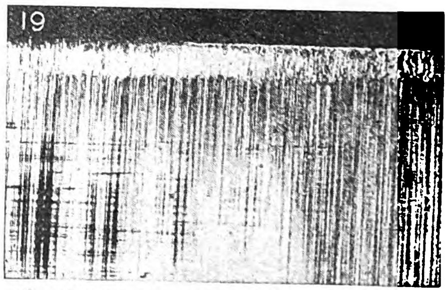
The smallest defects which will render a blade useless are not apparent at less than 200 diameters, and the present writer prefers to use 400 diameters magnification. In the case of a new blade, however, it will be found that if the cutting flanks and edge appear uniform and free from defects at 30 diameters, the blade will be as well ground and finished as is possible with the particular machines in use.

Safety razor blade makers are faced with the same problems which confront the manufacturer of high-speed tools and other cutting implements when they desire to test their product. It is a comparatively easy matter to measure the initial "sharpness," but it is quite another matter to measure the cutting durability and to obtain a figure of merit which will be a true criterion of shaving efficiency.



The same blade as in photomicrograph 17

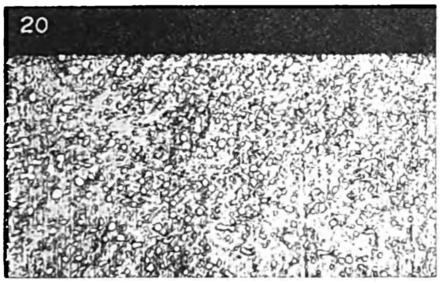
In a paper by Honda and Takahasi, (*Journal of the Iron and Steel Institute*, 1927, page 357) a sharpness testing machine is fully described. In that



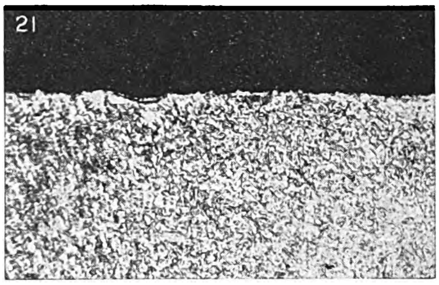
Same as in 18, except different position

---

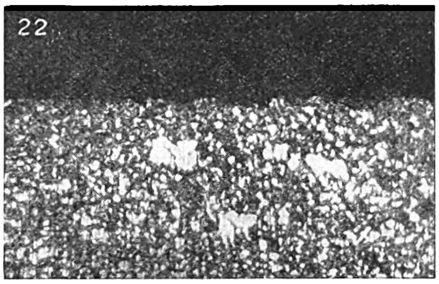
[2] *Journal of the Iron and Steel Institute,* (London), 1923, No. 1, page 249.



Globular cementite, structureless matrix

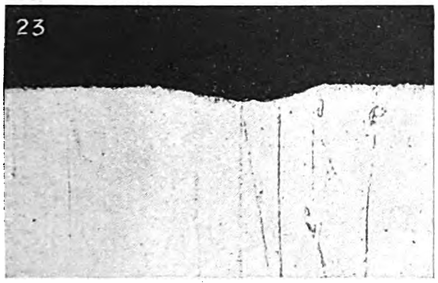


No good after only two shaves



Gave 15 shaves, then dragged badly

test, to quote from the original paper, "the cutting edge of the implement is brought into contact, under a definite pressure, with a narrow band, composed of sheets of paper about an inch in thickness, and a definite amount of forward and backward motion is given to the implement. The number of sheets cut during this motion is taken as a measure of the sharpness of the implement." A table is given showing the sharpness of various cutting implements, including a safety razor blade after the first, tenth, twentieth, fiftieth, and hundredth cut. The number of cuts required to reduce the intitial sharpness to half its value was defined as the life or the durability of the edge under test. According to the figures given, a safety razor blade cut through 85 sheets of paper at the first cut, and its durability was 3.5.

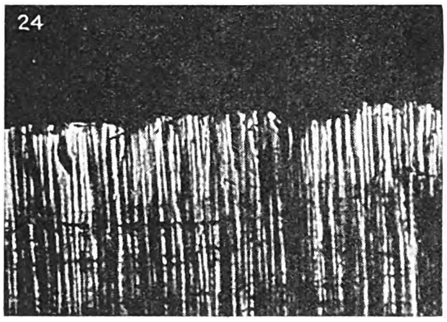


This worn one dragged uncomfortably

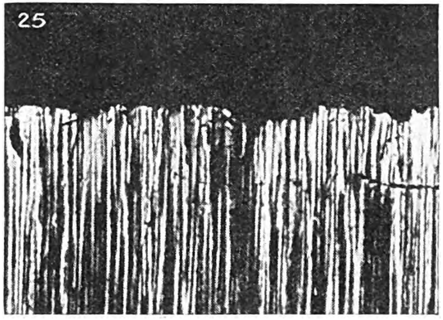
AT one time the writer contemplated making a somewhat similar machine, but found that a safety razor blade was completely ruined long before it had passed through anything like the number of sheets of paper quoted by Honda and Takahasi, as the number parted at the first cut. Unfortunately, the type of paper used in the original tests is not mentioned, but the author found that a blade which had been used to cut through 50 pages of the present journal would not shave at all.

So far as our present knowledge goes, it hence appears that the only satisfactory test for a safety razor blade is an actual shaving test, and as shaving is carried out so quickly and willing assistants who are prepared to test blades are always to be found in any works, good progress can be made without any special testing machine, although one would, of course, be desirable in order to put production on a really scientific basis.

In many factories it is the custom to test each individual edge, the test usually consisting of a test of cutting capacity. A hair is held between the thumb and finger of the left hand with one free end, and all edges must snip the hair cleanly when flicked across it. Satisfactorily hardened blades should also pass the same test after being pulled over a piece of soft horn with a pressure which is something of the nature of one to two ounces, the actual length of cutting edge bearing on the horn varying from one to three sixteenths of an inch. Those figures must not be taken too seriously, but are some rough idea of the nature of a test which is largely adopted.



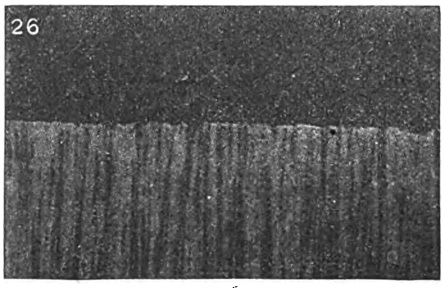
Photomicrograph of blade before shaving



Same blade after 15 shaves. Still good

THE following comment, which appeared in a subsequent number of *The Engineer*, was written by H. A. Curran, A.I.C., A.R.C., Sc. I. Accompanying it Mr. Curran published several of his own photomicrographs, and for the convenience of our readers these have been given serial numbers in continuation of those of the preceding part of the article. Mr. Curran states:

I have read with keen interest Mr. Kayser's valuable article on safety razor blades. Very few papers on this subject have been published, although undoubtedly a considerable volume of work has been done. One is led to conclude that the results obtained are treasured in secret archives under treble lock and key—a fact greatly to be deplored. The dissemination of scientific knowledge is the best and surest way of making further progress.

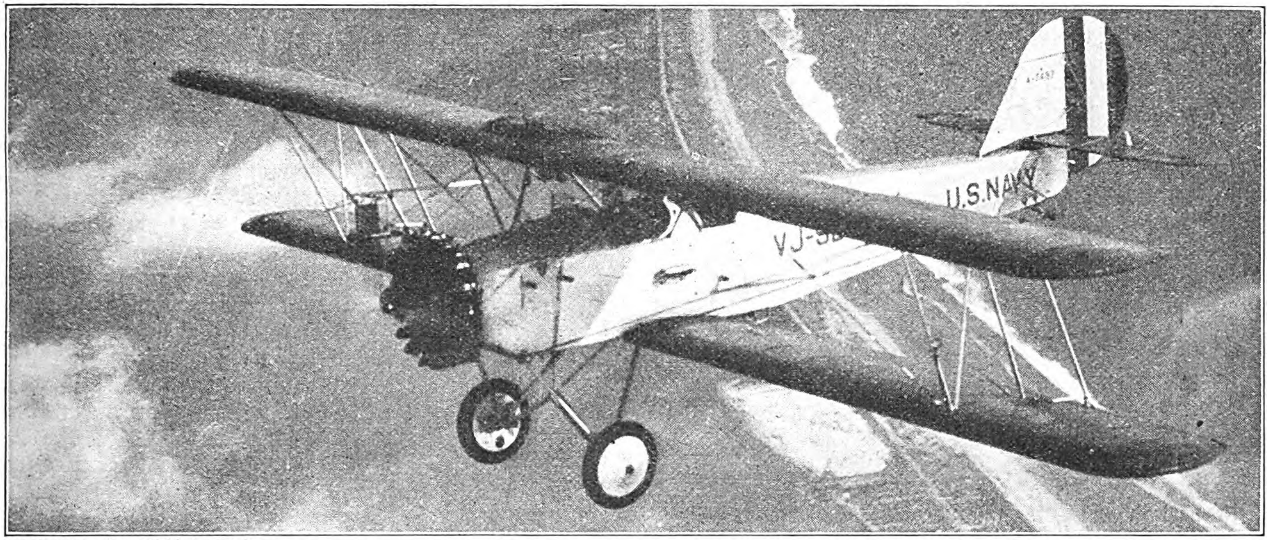


"The best blade I have ever encountered"

There is one point on which I would like to touch, and that is the shape of the edge at high magnifications. To quote Mr. Kayser: "Without exception, good safety razor blades exhibit a perfect edge at 400 diameters." This is a very broad and sweeping statement, and, if it were true, would be an extremely valuable generalization. I have had blades within the range of hardness specified showing very regular edges at 500 diameters, which would not yield a single comfortable shave. On the other hand, I have had blades, showing extemely irregular edges at 200 diameters, which give perfect shaves time and again.

Consider micrographs at 200 diameters of the same section of a single blade. Figure 24 shows it before shaving and Figure 25 after shaving 15 times. This blade was tested on every type of beard I could find, the user in every case praising it as giving a most comfortable shave. After each shave, the blade was wiped with a soft cloth, washed in absolute alcohol, and then oiled. It was not polished, stropped, or honed. The last shave I had with it was as comfortable as the first. Compare the edge before shaving and after 15 shaves. The difference if any, is imperceptible. The edge is very far from being perfect, especially when we remember that all irregularities in it would be doubled at 400 diameters.

This is not an isolated instance. I have had dozens of these in the course of a year. As a matter of comparison I enclose a micrograph, Figure 26, of the best blade I have ever encountered. Alas! I was forced to destroy it in the cause of science by cross-sectioning it.



United States Navy official photograph

NAVY TRAINING PLANE

Student fliers for the military services are put through many intentional practise spins so that they will get the feel of the maneuver and learn how to come out of it. This training plane can be brought out of a spin and under control easily

That 'Fatal' Tailspin

Most People Have the Wrong Idea of the So-called Tailspin; It Is Not Necessarily Dangerous and Is Preventable

By H. B. MILLER*

Lieutenant (j.g.) United States Navy

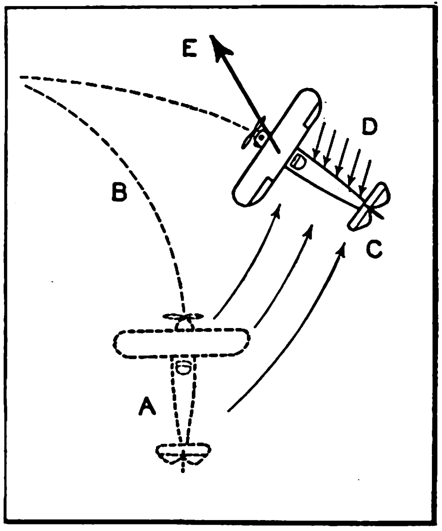
"PLANE Crashes to Ground!" Too often we have observed this headline in the daily newspapers. Somewhere in most of these stories the following words occur, " . . . the plane suddenly went into a nose dive and crashed." Co-incidental is the fact that these crashes occur during the process of a landing or a take-off, in the majority of cases; also, the fact that the pilot was new or inexperienced. The average person has, no doubt, connected these facts without being able to interpret them properly. Just what did happen?

Had the reporter of these mishaps been more observant or possessed a better knowledge of aeronautics, he would have further noticed two peculiarities of the "dive": first, that immediately preceding the disaster, the nose of the plane rose abruptly and, secondly, that the ship then began to rotate either right or left about its longitudinal axis. These symptoms show clearly that the crash was caused by a "spin."

THE original name for this maneuver was the "tailspin." This is a misnomer. People are led to believe that the tail of the plane is downward during the spin. This name was derived from the fact that when the plane is in this condition of "no control," the tail of the plane whirls dizzily around the engine end. The name "spinning nose dive" is more indicative of the ship's true action.

During the spin, the nose of the plane is down about 70 degrees below the horizontal. The plane then spins or whirls around a vertical axis which usually intersects the ship between the pilot and the engine. Sometimes, however, this axis is projected a considerable distance forward of the plane. Thus, a flat projection of the plane's spinning area may be quite large. It resembles closely the whirling descent of a maple leaf in the autumn.

The airplane as we know it at present is classified as a "heavier-than-air" machine. This is in opposition to the dirigible and other "lighter-than-air" craft which are supported in the atmosphere by the buoyancy of their inflation gasses.



ONE CAUSE OF TAILSPINS

The "skidding turn." Without banking his plane the pilot attempts the turn B, skids to C, gets the side-thrust D on the fuselage, and his resultant direction is E

Airplanes are supported during flight by the reaction on their wing surfaces of the passing air currents. These currents are created by pulling the plane forward through the air by means of a power plant operating a propeller. Gravity may be used for the same purpose by gliding the plane. Altitude, of course, must be sacrificed in this case. This is similar to the coasting of an automobile down hill. In other words, an airplane must move forward at more than a certain critical speed to maintain itself in the air.

THE minimum speed at which any type of plane will support itself in the air is called its "stalling speed." If the speed of the plane is reduced below this critical or stalling speed, it will fall like any object that is heavier than air. Due to the peculiar arrangement of wing and tail surfaces, it rotates as it falls. This is the spin.

Loss of flying speed is brought about in various ways. Generally, it is a result of climbing the plane too steeply. The engine may not have sufficient power to pull the plane forward at flying speed at this extreme climbing angle. The plane stalls and spins as a result. Similarly, a low-powered car will not climb too steep a hill.

Or perhaps the pilot is climbing his

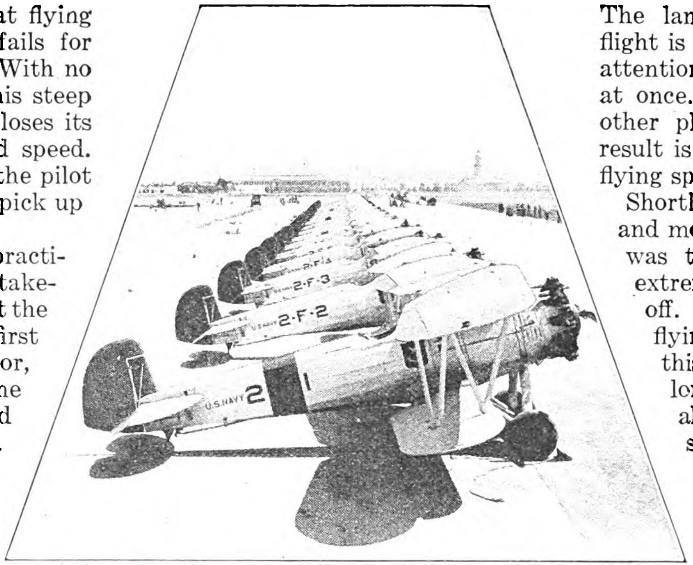
---

*See "Among Our Contributors," page 279.

ship to the utmost, but still at flying speed. Suppose the engine fails for any one of a dozen reasons. With no power to pull it forward at this steep angle, the plane immediately loses its slight safety factor of forward speed. It whips off into a spin before the pilot is able to nose over in order to pick up flying speed for a safe glide.

These two conditions cause practically all of the crashes on the take-off. Note that the engine is not the reason for the crash in the first case. True, it is a contributor, but the fault lies directly at the pilot's door. The ship would have been safe if the pilot had not climbed so steeply.

The cool-headed and proficient flyer keeps his ship's nose low until he has gathered safe flying speed. Then, and only then, does he begin to gain altitude. If his engines should cut out, he has sufficient surplus speed to place his ship in a safe glide preparatory to landing.


United States Navy official photograph

A SQUADRON OF NAVY FIGHTERS

These planes have no tendency to spin because of the perfect aileron control available through the long, narrow ailerons

EVERY plane has a definite glide ratio depending upon several factors; that is, weight, wing area, et cetera. The average ship will have a ratio of approximately seven to one. In other words, for every foot of altitude the plane has, it will glide forward seven feet. If the plane is 100 feet in the air, it will glide to a point 700 feet away, providing, of course, that there is no wind.

The glide of a power-operated plane can not be "stretched." That is, it can glide only a certain horizontal distance for a given altitude. If the engine is stopped while in the air, the plane can land no farther away than the point where his safe gliding angle intersects the ground. The pilot can land short of this, of course, by side slipping. It is unfortunate if he is too far away from a good field.

Suppose the novice aviator is in a plane having a glide ratio of seven to one. He is at an altitude of 100 feet with a "dead stick" or with his propeller stopped. The only good field is 900 feet away. In an effort to force the plane to glide father than it actually can, he pulls the nose of his ship higher and higher in order to flatten out the glide and thus reach the field. Eventually he will lose flying speed, and spin to the ground. This condition of flight provides practically all of the crashes during a landing when "the plane suddenly dived to the ground."

Another prolific cause of spins is the "skidding turn" at a low altitude. A plane must be banked in proportion to the radius of its turn. A blindfolded passenger would be unaware of a properly executed turn. If a plane is not banked sufficiently, it will skid around a turn exactly as a swiftly moving automobile skids outwardly around a sharp corner. As the plane skids it presents a projected area of its fuselage broadside to the direction of flight. This sudden resistance causes the plane to lose part of its forward speed. If this condition is aggravated, the plane will lose flying speed and fall off into a spin.

These, in short, are the causes of most accidental spins—and crashes. Since all of this is known, why doesn't the pilot watch his speed carefully?

The landing and take-off period of flight is a busy one for the pilot. His attention is on many different things at once. He must watch closely for other planes and obstructions. The result is that he may not observe the flying speed of his ship closely enough.

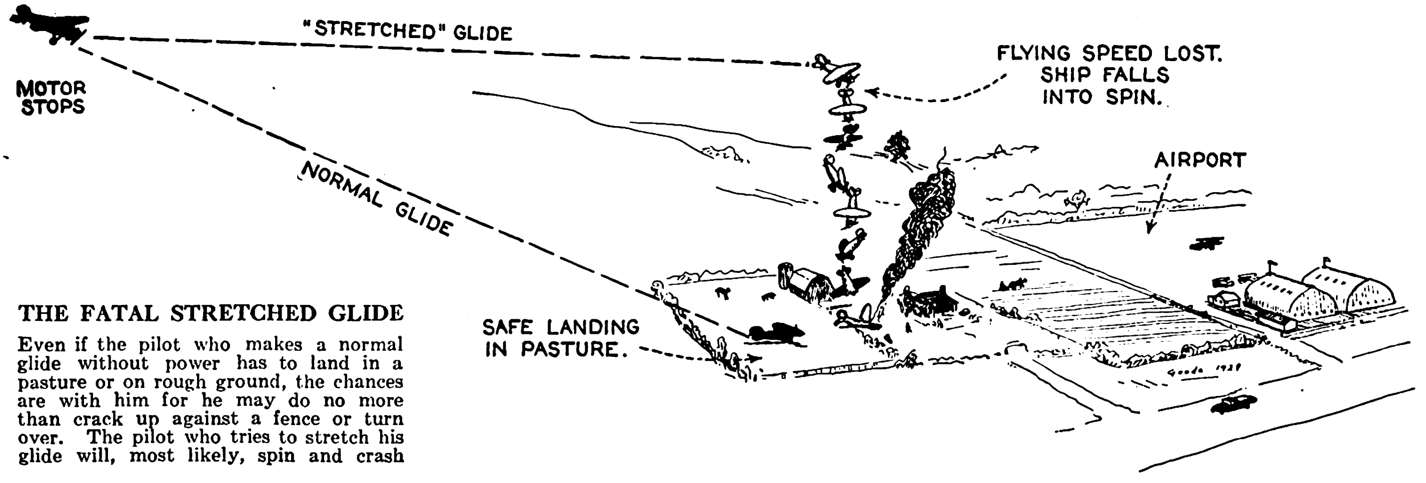
Shortly after the war the favorite and most dangerous stunt of aviators was the "chandelle." This is an extreme climbing turn from a take-off. The list of pilots who lost flying speed and "spun in" doing this unnecessary maneuver is long, indeed. It is forbidden at all regulated airports. A straight steep climbing take-off is nearly as dangerous, and equally as useless.

Most newly-hatched pilots are obsessed with the necessity of showing off their recently developed skill to the admiring throngs. It is much safer to observe the skill of these new pilots from the ground than from their rear cockpits.

The adjective *fatal* has been unconsciously attached to the word *spin.* Spins are dangerous under an altitude of 500 feet because it usually takes several hundred feet in which to recover control of the plane. This results in the axiom that the first 500 feet is the most dangerous part of flying. This is true for the untrained pilot. An experienced pilot will not allow the plane to approach a stalled condition.

THE training of all aviators should cover the spin thoroughly. The student should be placed in them often until he can unconsciously recover from them. He should be taught the warning signals that accompany a stall. They are so numerous that a pilot must be absent-minded, indeed, who does not heed them and take action.

When flying, the interplane brace wires have a clear whistling sound. The plane is stable and the pilot, through his control stick, can feel a distinct air pressure on the control surfaces. In addition, there is gener-

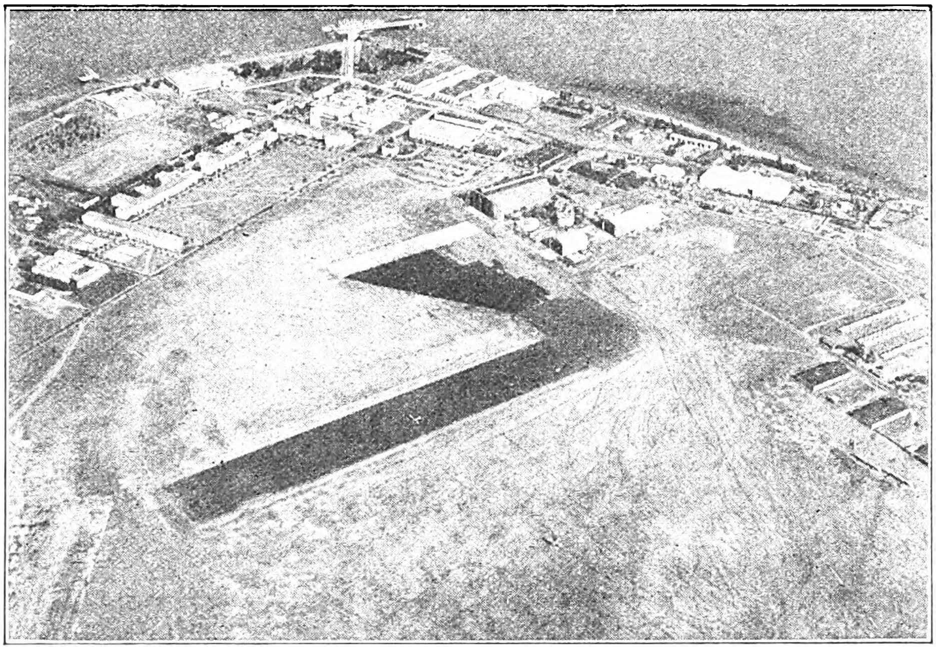


THE FATAL STRETCHED GLIDE

Even if the pilot who makes a normal glide without power has to land in a pasture or on rough ground, the chances are with him for he may do no more than crack up against a fence or turn over. The pilot who tries to stretch his glide will, most likely, spin and crash erally an airspeed meter to give him his actual speed through the air.

When the plane begins to approach a stalling point the wires no longer sing merrily—the old saying is that "either the wires or the angels will sing to you!" No longer is the ship a steady platform. It shakes and trembles. The controls are sloppy and loose. No air pressure can be felt on them. The slowly moving ship no longer responds readily to the controls. The airspeed meter will indicate clearly a dangerous flying speed.

All of these warnings fairly shout out to the pilot. He who fails to interpret them correctly is improperly trained or indoctrinated. In either case he is a menace to the further development of aviation and should not be permitted to fly.



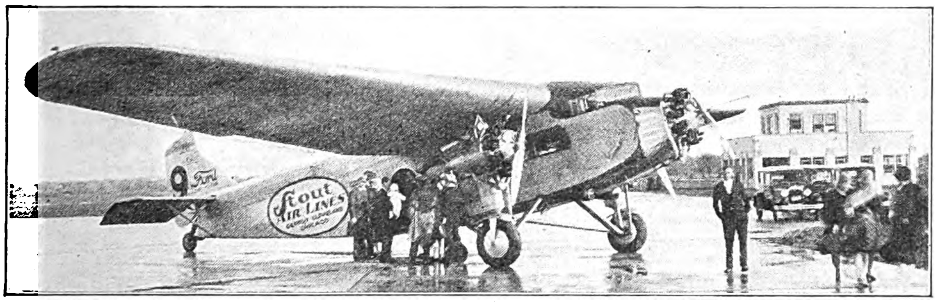
United States Navy official photograph

FOR BOTH LAND AND WATER TRAINING

The Naval Air Training Station at San Diego, California, where prospective navy fliers are given preliminary instruction. It has facilities for airplane and seaplane training

FOR the properly trained pilot, recovery from a spin is very easy. He simply neutralizes the controls and throttles down the engine. To come out quicker, he dives the ship and applies the rudder opposite to the direction of the spin.

Means of recovering from a spin were discovered during the war when the maneuver was used to deceive the enemy into thinking the ship had been shot down out of control. Post-war tactics have condemned this practise. The aviator who should attempt it in the event of a war now would find himself riddled with machine gun bullets. But the spin, as a training device, teaches the student aviator to retain his senses and bearings under trying conditions. It also teaches him how to recognize and recover from it. Further than that it has very little practical value.

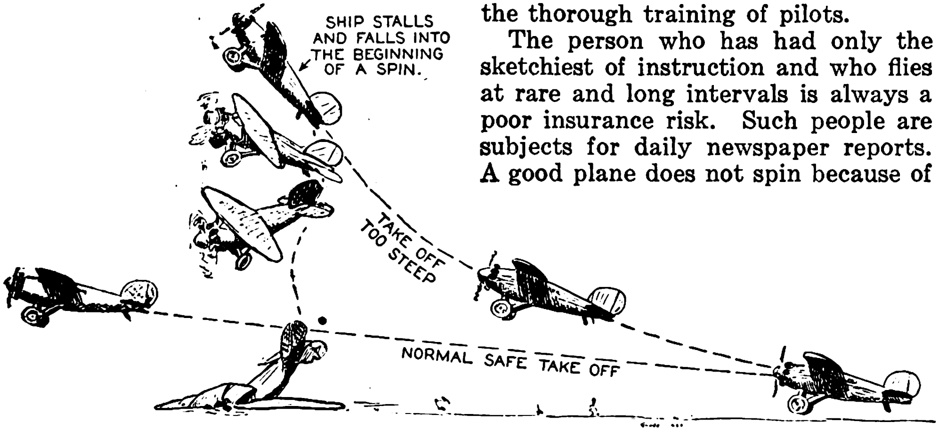


FLY FROM A WELL MANAGED AIRPORT

"Enjoy your ride with the assurance that the company can afford to hire only good pilots"

Various devices are being developed to do away with this danger. The success of these inventions has been varied and the final mechanical solution of the problem has not been reached as yet. The most efficient method of eliminating this menace is the thorough training of pilots.

The person who has had only the sketchiest of instruction and who flies at rare and long intervals is always a poor insurance risk. Such people are subjects for daily newspaper reports. A good plane does not spin because of its characteristics; it spins because of the pilot's deficiencies.


SHIP STALLS AND FALLS INTO THE BEGINNING OF A SPIN.
TAKE OFF TOO STEEP
NORMAL SAFE TAKE OFF

THE FIRST 500 FEET ARE THE MOST DANGEROUS

A sketch that tells its own story except for the important detail that the pilot in the plane shown crashing is most likely a newly-fledged aviator who wants to "show off" his skill

The anxious mother who admonished her son that if he was determined to be an aviator, he must fly slowly and low, did not know her airplanes. No one has ever gone into a spin from too much flying speed.

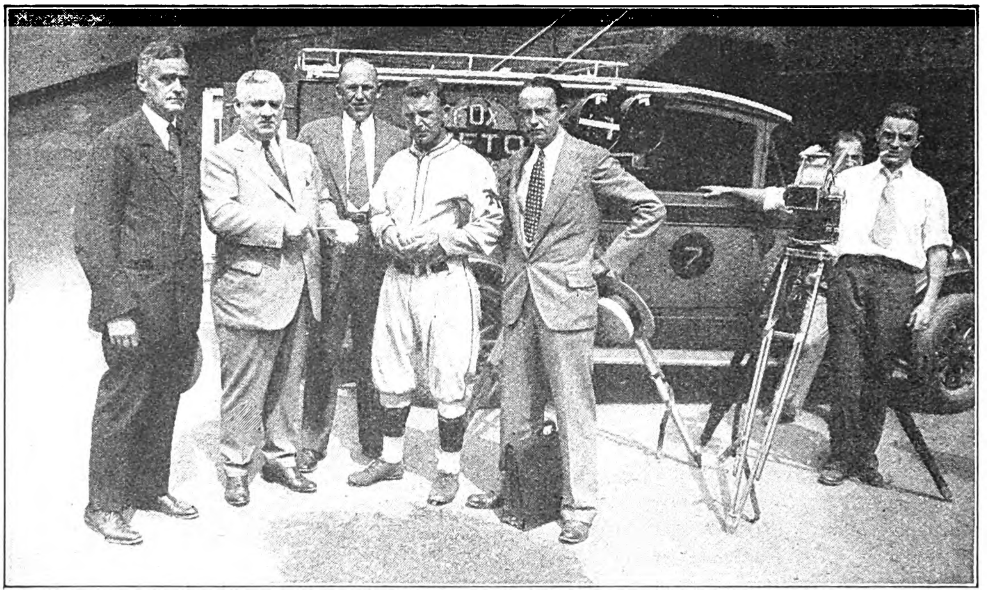
Beware of your friend who wants to take you up to prove that he can fly. Is he a good flyer? Certainly, for didn't he solo just last month in the remarkable time of two hours and thirty-five minutes dual instruction! Let him thrill someone else. Instead, drive out to some legitimate and well-managed airport. Take your flight with a recognized organization. Enjoy your ride with the assurance that the company can afford to hire only good pilots.

At this time the spin still is the bane of aviation. This applies mostly to amateur and untrained pilots. It is true, of course, that well-trained professional aviators crash from spins, but the relative percentage is small.

This maneuver is sufficiently dangerous, however, to cause Admiral Joseph M. Reeves, recently Commander of Aircraft Squadrons, Battle Fleet, to issue to his command of close to 350 seasoned aviators a memorandum. It was to the effect that all naval aviators should observe closely the three fundamental principles of aviation, to wit:

1. Keep flying speed.
2. Keep flying speed.
3. Keep flying speed.

IF government trained pilots are warned continuously in this manner, what warning must be necessary to the flyer who scarcely keeps his hand in aviation?



OBSERVERS OF THE TEST

Left to right: The author, J. J. McGraw, Ed. Thorpe, Ray Schalk, S. J. Liddy, cameraman

The "Lively" Ball

Tests Conducted by Scientific American to Determine Whether the Present Baseball Is Livelier Than the Old, and if So, Why

By LOUIS S. TREADWELL

Associate Editor

WHEN we were approached by Mr. John J. McGraw, Manager of the New York Baseball Club, to conduct a test on the baseball now used by the major professional leagues, the situation presented many difficulties and at first a line of procedure, which would be conclusive, was not at all evident. However, there is such a widespread interest in the question that the difficulties served but to arouse our interest and determination to find a solution that would be satisfactory. The following method of procedure was finally selected as a general outline.

Analytical Test. Weigh and caliper ball and note general appearance as to sewing, leather, and so forth. Unmake ball and measure and test various materials of which it is constructed. Compare materials of 1924 ball as against the 1929 ball. Analyze batting records to determine if there has been any considerable change in the physical performance of the players themselves. Analyze the batting performance in connection with changes in the dimensions of the playing surfaces of the various baseball parks.

Physical Test. Drop balls of various years from a height and note the comparative distance of rebound, making allowance for deterioration due to age, use, and so on.

It is assumed that the National and American League balls are made under the same patents and are similar, being made in the same factory, one being stamped Spalding-National League, and the other, Reach-American League.

On August 13th at the Polo Grounds, through the courtesy of Mr. McGraw and the help of Mr. Christy Walsh, a test for resiliency was made by dropping four balls from a simple trap which would assure that all four were released at exactly the same moment. These were dropped from the balcony upon the floor of the stand approximately 40 feet below, and the entire flight of the balls was recorded by motion picture cameras. For this purpose the following balls were selected:

1.—One new 1929 ball, just received from the manufacturer.

2.—One unused ball issued early in the 1929 season.
(Both above chosen at random from regular stock.)

3.—One slightly used but entirely undamaged 1929 ball.

4.—One unused 1924 ball.

About ten tests were made; each individual ball, being previously marked, was released from the same relative position. The results obtained were as follows:

Ball No. 1 above rebounded a few inches higher than ball No. 2.

Ball No. 2 rebounded from 18 inches to two feet more than ball No. 3 and ball No. 4 rebounded a few inches more than ball No. 3.

"Stills" of the motion pictures confirm the testimony of numerous observers, as above.

In the laboratory tests the following characteristics were determined:

1924		1929
5 oz. + +	Weight	5 oz. +
2⅞ in.	Diameter	2⅞ in.
	Cover attached by rubber preparation	
June 29-4	Manufacturer's tag marked	May 29-266
6 per inch	Stitching thread (37⅜ in. each, black and red)	6 per inch
112.3 yds.	Fine linen thread	88 yds.
57.1 yds.	Gray yarn (light)	52.6 yds.
48 yds.	White yarn	42.3 yds.
96 yds.	Gray yarn (heavy)	87 yds.
1 5/16 in. diam.	Rubber center	1 5/16 in. diam.
¾ in. diam.	Cork core	Irregular

The weight of the component parts of either ball check closely with the corresponding parts of the other ball and after disassembly weigh exactly five ounces each.

AN analysis of the rebound test would not be conclusive unless it could be supported in any of its features by other evidence. The difference in the rebounds between the two 1929 balls was slight and not particularly indicative, inasmuch as part of the difference might result from the variance in performance of two individual samples or the striking of one ball upon a seam. The rebound of the used 1929 ball, however, shows that considerable resiliency is abstracted by a comparatively small amount of use, this being further confirmed by the fact that the new 1924 ball rebounded farther than the used 1929 ball, and at the end of the test the more resilient balls were not rebounding so high; the variation of this height between all the balls was markedly less.

In the results of the laboratory test it will be seen that the 1924 ball was a shade heavier than the 1929, but this can readily be accounted for by the increased amount of moisture absorbed in the intervening years. In general characteristics the two balls are quite similar, the only variation noted being that the yardage of the four elements used in winding, making up the interior of the ball, is less in the 1929 ball, although the center rubber in each instance is the same diameter, and no particular variation in this respect, or in the leather covers of the balls, allowing for five years depreciation, is noted between the 1924 and the 1929 ball. (The irregularity of the cork core in the 1929 ball is of no significance—several other 1929 balls that were also cut open, show perfect spheres of cork.)

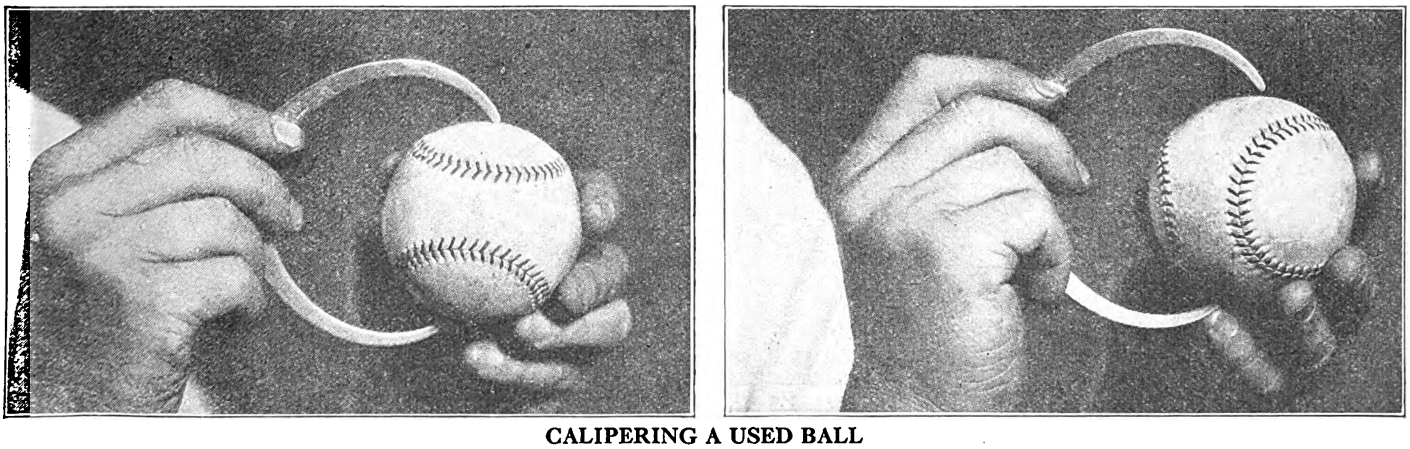
The accumulation of yardage in the 1929 ball being considerably less than the accumulated yardage of the 1924 ball, the materials must necessarily be either of larger individual bulk in the 1929 ball, or these were wrapped more tightly in the 1924 ball, or the yarn in the 1924 ball was permanently distorted due to being under strain for five years.. As the ultimate weight of both balls is the same, and it is believed that permanent distortion would not produce such a difference in yardage, it is evident that the materials used in the 1929 ball must have been wrapped under less tension than the 1924 ball, and hence would have greater resiliency, inasmuch as these corresponding elements in both balls are practically alike. An examination of the heavy gray yarn which is the first covering of the rubber center confirms this and shows 87 yards are used in the 1929 ball as against 96 yards in the 1924 ball. This in conjunction with the other items of the 1929 ball shows conclusively that, while the same grade of yarn is used, the lighter tension yarn nearer the center of mass of the ball would certainly increase its ultimate resiliency. Also the shorter yardage of linen thread wound immediately beneath the cover would tend to make the 1929 ball more lively. Here we have no consideration of deformation to apply as thread will not materially change its essential characteristics under these conditions. This analysis is confirmed in the rebounds of the drop test.

THE DROP TEST

A magnifying glass used on this film shows distinctly four balls rebounding as described in the accompanying text. Photograph is enlarged from a motion-picture film

Another fact was developed in the examination of the used 1929 ball. Careful external calipering of new balls indicates almost no difference in diameters at various axes around the ball more than what is known among mechanics as "a touch" of the calipers, which shows a surprising excellence of manufacture, considering the variety of the component parts, whereas in the slightly used ball as much as $\frac{3}{16}$ths of an inch difference in diameters over right-angle planes was shown. It is obvious, therefore, that a used ball would give a pitcher better results, particularly with the old-fashioned "trick" deliveries, for it can be thrown absolutely straight only when the tendency to irregular flight caused by the unequal bulge or deformation is entirely counteracted by the twist given to the ball by the pitcher. This would be an almost impossible combination. Conversely, where the twist given by the pitcher and the curvature of flight given by the deformation are operating at the same time an unusual result can be obtained. Also, in the flight of a batted ball, the zig-zag course of the center of mass produced by the deformation or bulge would tend to cause irregular flight and the used ball would not be driven as far with the same impact as a true sphere would be.

This phase of the subject would not be of importance if we were dealing with low speeds. But authoritative tests of Walter Johnson's speed showed that his pitched ball attained a maximum of 122 feet per second. Obviously a hard batted ball, being projected further, will attain a speed consider-



CALIPERING A USED BALL

Use distorts a ball. Calipering shows a difference in diameters of the same used ball of 3/16ths of an inch ably greater. The contention of irregular flight therefore has a rightful place in this general consideration.

It is a fact that as many as ten dozen new balls were used up in one game recently. It is evident, therefore, that a new ball is presented to the batter much more frequently than under old conditions, which undoubtedly places the pitcher more at a disadvantage and gives the batter an added advantage over the old conditions. Also one of the largest manufacturers of bats reports that this year their total production of the old style "choke" bat was only 6 percent and that many of them still remain unsold, showing that a preponderant majority of players use the thin-handled bat. Also it is an undoubted fact that since 1919, when Ruth made 29 home runs, and his subsequent sale for a then extravagant sum, the average "sand lot" player has been imbued with the idea that the so-called "slugger" is the one that gets ahead and from the inception of his baseball career he studies and emulates the great home run proponent.

The leagues are now filled with batters who have, during their professional careers, studied and strived for long hits. This is the testimony of managers and scouts. In fact one scout frankly testified that he knew of many instances where every other feature of play, including mentality, was minimized in the scout's report on the player in favor of the man's ability to hit them out. Prominent managers also testify that the fine points of the game are now neglected because of this one-sided development, for the reason that certain vociferous elements among their patrons are keen for this kind of game.

MANUFACTURING

Ten steps in manufacturing are necessary, stitching being the only hand labor done

An analysis of batting averages shows that very little which is germane to this test can be deduced from Ruth's batting record, save that in the years when he obtained the most home runs he played almost the entire season's schedule and his general average was .376 or better. Only during 1927 and 1928 did his general average in great home-run years fall below that mark. It is testified to by competent observers that Ruth has not been getting longer drives in the last years than he formerly did, although one manager states that some of his players are getting the longest hits of their careers.

There is also nothing in the Champion Batsman record to help to any determination. Of late years Hornsby batted .401 in 1922, .424 in 1924, .403 in 1925 and .387 in 1928, he being the only one to exceed .400 since Delehanty in 1899 with .408. Last year Hornsby also led in slugging percentage (total bases to total times at bat) with .632 although he drove out but 21 home runs as against Bottomly and Wilson with 31 and Ruth 52, and stood fifth in total home runs batted out in his league. In the National League in 1928, 34 players in 60 games or over batted for a general average of over .300, this list including the five leading home run hitters. In the American League similarly 35 players batted over .300, the leader Goslin, with an average of .379 getting 17 home runs, to be third in this list. This League does not have as many high individual performances as the National.

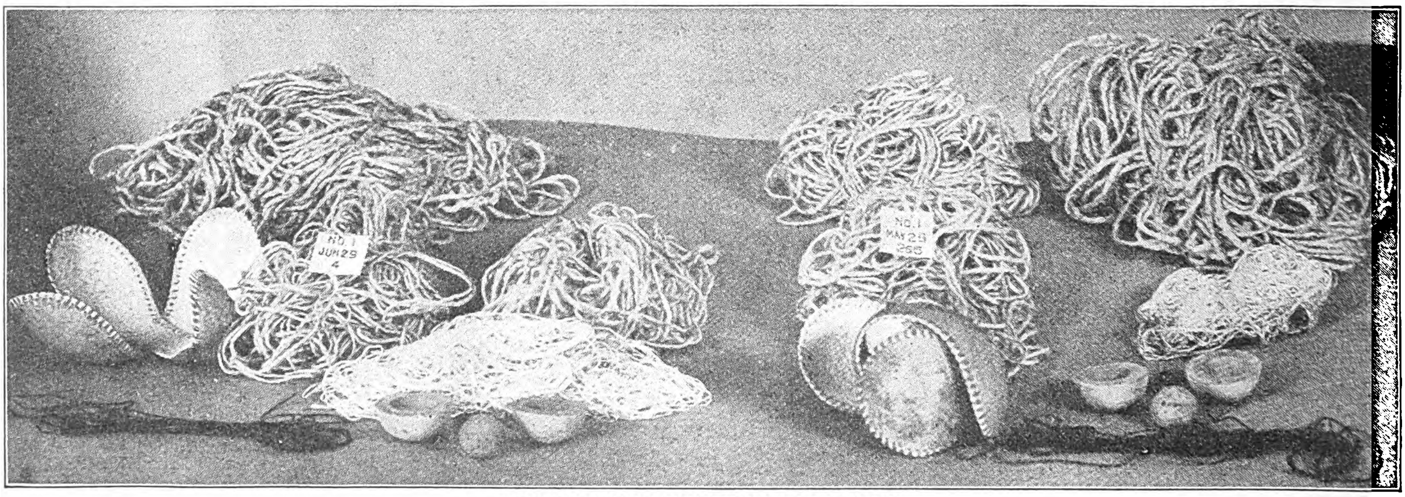
Home run hitting apparently, therefore, is not an essential requisite for high individual batting averages, although the best batter will naturally be high on this list.

The greater number of .300 hitters in both leagues is explained more reasonably by a combination of all the changed conditions co-incident with the advance of skill in the game, together with a slight increase in liveliness in the ball now used.

Another phase which may have significance or not according to the judgment of the individual scorer, is the practice of scoring hits where formerly errors would have been given, and crediting the batter with a sacrifice on long-driven balls even when the batter made no attempt to sacrifice. One well-known manager states that he sees "plenty of hits made that I know are errors." If one can judge by the evidence of skilled and experienced baseball writers their judgment on frequent occasions would confirm this.

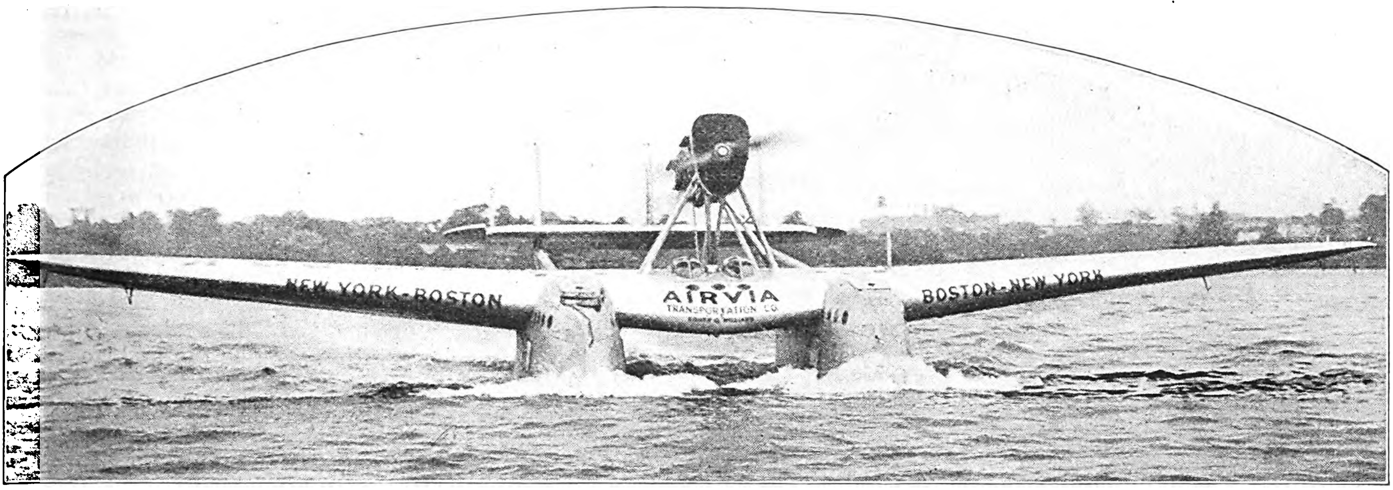
The statement that there are now more injuries to players due to a livelier ball does not seem to be maintained. As so many players are trying to "kill the old apple" it is certain that where they fail to lift the ball, it will be driven more often than formerly through the infield at great speed. There is disagreement among prominent managers as to whether there are more injuries in the present game than in the past.

While the study of change of playing space in the baseball parks in relation to home runs would be interesting, the data would take too long to compile for this test and is considered in no way to affect the final determination.



MATERIALS USED IN BASEBALLS

Eight elements of highest grade make up a finished baseball. Note the similarity of manufacture of 1924 ball, left, and the 1929 ball. Refer also to the table in the text wherein is given the proportions of the various materials used five years ago and at the present time



NEW YORK TO BOSTON IN TWO HOURS

Two of these 12-passenger Savoia-Marchetti flying boats were recently placed in service between North Beach, Long Island, and Boston. Reliable planes, operating on schedule, show the trend of the present day toward the stabilization of aerial transportation

What Is the Future of Aviation?

"Remarkable as Has Been the Growth of Flying, Still More Vital Developments Seem to Lie Just Ahead"

By REGINALD M. CLEVELAND[*]

IT seems highly probable that when the historians of 2929 compile the records of our era they will classify it as the "Age of Motors," just as historians of our own day have characterized eras in the buried past as the "Age of Bronze" and the "Age of Stone." For upon the last quarter century is indelibly stamped the mark of the electric motor and the internal combustion engine.

In the relatively short space of time since the "horseless carriage" of our fathers brought gaping crowds to watch its progress through the streets at the reckless speed of eight or ten miles an hour, the whole face of our civilization has been changed by the expanding use of the automobile.

Last year 1,044,173 more cars were produced in the world than in the year before, bringing the total world production up to 5,203,139. Of these, the United States and Canada produced 4,601,141 or 88½ percent. Together they contributed 1,020,761 of the increase as against 23,412 for all the other countries in the world. One half of all the motor cars now operating outside of the United States were made in this country.

But the internal combustion engine has had another gift in store for the 20th Century. Just as it "grew" tires, it is now sprouting vigorous wings, and America has already crossed the threshold of opporunity into the age of flight. To those who can recall the beginnings of the automobile era, the speed and variety of aeronautic development is little short of breath-taking.

Three years ago, the United States lagged behind the world in nearly every department of flying. Pioneers were still doggedly preaching the gospel of the air to inattentive ears. Ardent advocates of national defense were endeavoring to arouse an apathetic government to the importance of the flying corps. Struggling manufacturers of aircraft were meeting the chilly skepticism of bankers in an effort to increase very modestly their output.

Two years ago, a young American airmail pilot linked Roosevelt Field with Le Bourget in a lonely and unexampled flight across the Atlantic, and not only leaped into world fame over night, but touched spark to tinder and lighted a blaze of enthusiasm for aviation which burns more brightly day by day.

A year ago, America surged abreast of world aviation.

Today, the United States dominates the sky.

FROM the anemic and unpromising infant of three years ago, aviation has already become another of the American industries in which 1,000,000,000 dollars has been invested. So rapid has been its growth, so contagious the doctrine of air-mindedness which was preached in vain but a short while ago, that it is difficult to keep pace mentally with the developments from month to month and from day to day.

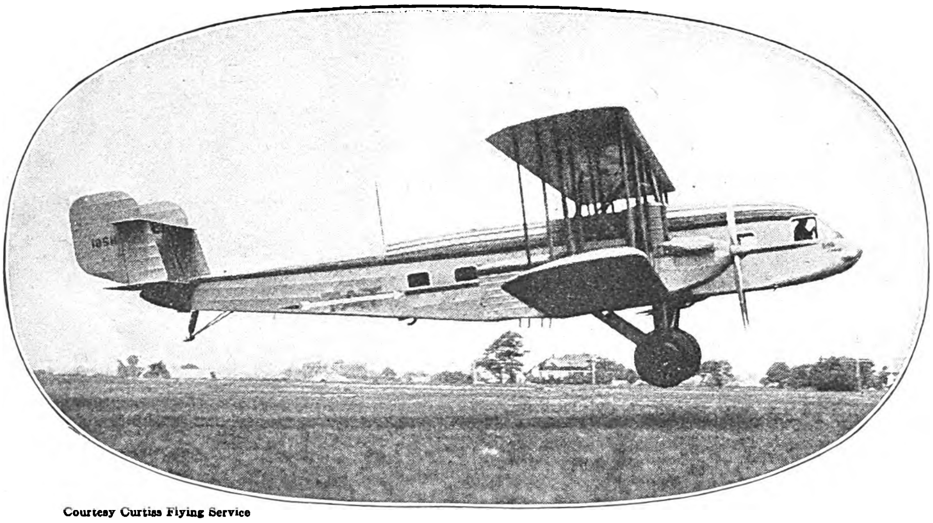
With a rapidity unparalleled in American industry, the stage of mergers has been reached by this young giant. Already the handwriting on the wall shows that the business of aviation in the United States is to be controlled by a handful of strong combinations with comparatively few—and these the financially strongest—independent manufacturers and operators able to keep the pace. The rush of public money to aviation stocks has alarmed leaders in the industry itself, and conservative financial opinion points out that the earnings for 1928 could not exceed 1 percent on a market valuation which has appreciated 2000 percent in three years.

Approximately 4500 airplanes were manufactured last year in the United States. Estimates for 1929 put the figures at 9000. Airplane exports have tripled in a year. Air transport operators flew some 8,000,000 miles in the first six months of 1929 as against 10,510,000 for all of 1928. The total length of the airway network is now estimated at 30,000 miles as compared with 16,667 at the close of the year. Of the existing airways 10,000 miles are lighted as against less than 7000 at the end of 1928. Forty thousand passengers were carried in the first six months of this year and but 35,000 in the twelve months preceeding, while, in the first half of 1929, airmail transported was estimated by Secretary of Commerce Lamont at 3,400,000 pounds compared with a total for 1928 of 4,061,210 pounds.

In the aircraft industry 1950 concerns are now engaged. There are 575 aviation schools—an increase of 110 over last year—and more than 12,000 student licenses are in force. Airplanes under American ownership in passenger, mail, express, and freight

---

[*] See "Among Our Contributors," page 279.



Courtesy Curtiss Flying Service

THE TWO-MOTORED CURTISS CONDOR

Two Conqueror engines of 635 horsepower each give this 18-passenger biplane a top speed of 139 miles per hour and a cruising speed of 116. Every passenger comfort is provided

service, are flying on an average of 75,000 miles a day.

But the statistical side, impressive as it is, is but a small portion of the vista which unfolds itself to the observer of aviation in the United States. The enormous gains which have been made are, perhaps, less astonishing than the multitude of services which the airplane is finding to perform, and the improvements in aircraft design and construction.

Already the airplane is beginning to affect daily life from almost as many angles as has the automobile. Aside from its usefulness for speedy mail carriage, it is entering week by week into new phases of passenger transportation. July saw the opening of two air-rail systems from coast to coast and the announcement of others, cutting the time of passage from Atlantic to Pacific to a 48-hour schedule in the case of the fastest of these services. These transcontinental systems are extensions of the partnership between the "Iron Horse" and the "Ship of the Air" which has already been tried successfully for shorter hauls. They are based primarily upon the thought of sleeping in the familiar Pullman car berth at night and flying in the luxurious chair car of the sky by day.

ALL-AIR schedules from coast to coast will be in operation this fall, some of them providing only comfortable reclining chairs for the night part of the journey; others sleeping compartments. This will mean 30 hours from the Golden Gate to Broadway. It is safe to predict that both the air-rail and the all-flight long-haul services will find a growing patronage.

Chartered plane or taxi service is finding an astonishing growth in many key cities. Indeed, it is so definitely a business that a rate war is imminent in New York and a flat figure of 25 cents a mile anywhere in the United States has been announced by one company.

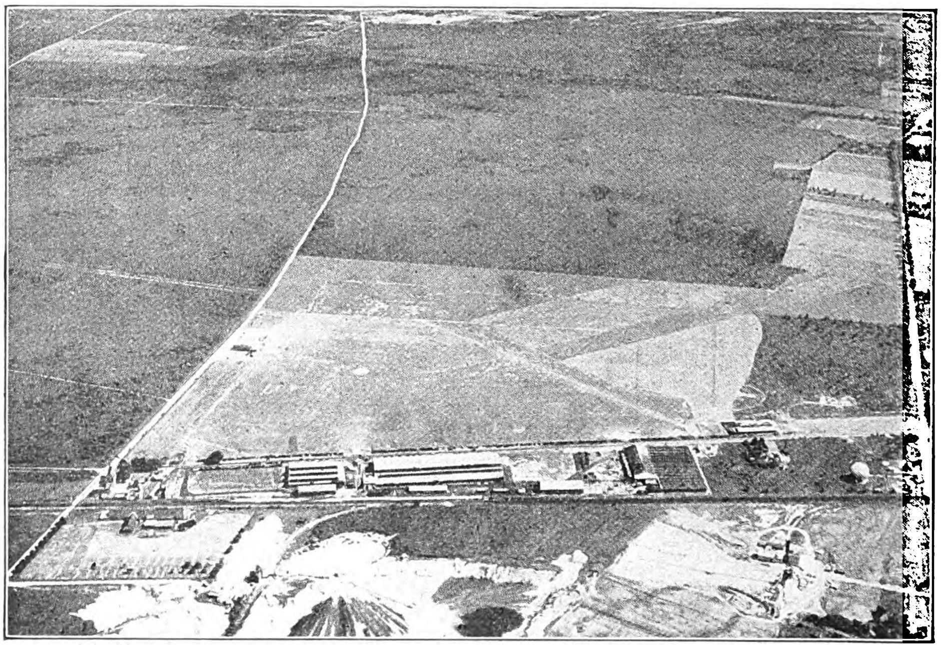
Commuting by air also becomes each week a more commonplace procedure. One service from New York to Boston has a number of flying commuters who go now from airport to airport in one hour and forty-five minutes as contrasted with the accustomed five hours on the fastest train. Flights to resorts such as Lake George, Atlantic City, and Long Island Sound points, are common, and similar services are growing up around cities other than New York.

In operations of this nature and in commuting lies the germ of another profound effect which aviation may exert upon our civilization. As the motor car made possible rural dwelling with urban work to a degree totally unattainable by horse transportation, so the airplane may easily push out the boundaries of the suburban zone, and bring relatively remote regions into metropolitan areas with consequent great appreciation of real estate values and a different fabric of the whole business of existence.

Special uses of the airplane multiply with astonishing rapidity. Following the lead of the Dutch in service to London, airplanes transport perishable flowers and out of season fruits to market. They are regularly employed, and most efficiently, in the dusting of crops and the fight against the pests of vegetation such as the boll weevil and the spruce bud worm. They are the eyes of the tax assessor, and in as widely separated localities as rural Connecticut and the Belgian Congo have brought to book those miscreants who were seeking to evade payment of local levies.

AT the international boundaries, the air patrol is often effective in apprehending the ubiquitous bootlegger and the more dangerous drug-runner. Planes play a part in other types of law enforcement, and have proved of help to the police in the Argentine and along our own Atlantic shore where they have become part of a regular checking system operated by the Coast Guard. It is predicted that fire-fighting with chemicals will soon be carried on from the air, just as now fire detection in the great forest areas is greatly simplified by the use of observation aircraft.

In surveying and mapping, important strides have been made from the point reached in aerial photography during the World War. The United States Army has conducted tests in which air photographs made at night of Leavenworth, Kansas have been transmitted electrically to Los Angeles



Courtesy Fairchild Aviation Corporation

AN AIRPORT FROM THE AIR

Widespread use of airplanes is impossible without well designed airports. As these become more numerous and evenly distributed, civil flying will show a substantial increase and New York simultaneously in 40 minutes from the time of the exposure.

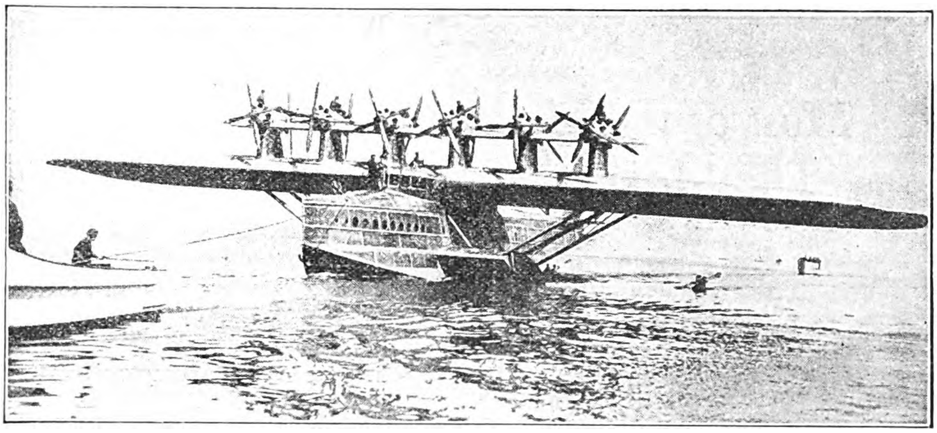
The use of the airplane for exploration is of course not new, but is being widely extended and its worth in this regard, especially in difficult terrain, is amply attested by the reports coming from Commander Byrd on his Antarctic Expedition. The Alaskan survey was continued by air this summer, and the right of way for a new railway in the Canadian Northwest was determined also by the aid of flying.

INSPECTION flights of various kinds become frequent, and it is obvious that no better method of inspecting airports can be found than from a plane. A transcontinental trip of this nature was recently made by Senator Webb of New York in order to gather data for the State's prospective airports. Hunting by airplane is extended, and the smuggling of aliens by plane has also been reported.

The emergency uses of the air where time is a vital factor are of course legion. A little while ago a son arrived by plane just in time to prevent the foreclosure of a mortgage on the family homestead. Vaccines go to far places borne by wings to save life. Doctors fly to patients whom they could not otherwise reach in time, and the plane frequently performs an errand of compassion in uniting families about some far-off death bed.

The airplane enters into business from very many angles. It makes light deliveries, it speeds executives from office to plant, it promotes sales, it flashes or writes the advertiser's message on the sky. It is said that one third of the airplanes sold in America last year went to private business organizations. Publishers, banks, utility companies, radio manufacturers, department stores, fur dealers, real estate operators, and men in a dozen other walks of life use the plane to speed their business. The traveling salesman travels under pressure higher and at a rate faster than he ever dreamed of before.

Women are taking rapidly to wings. One flying school in Kansas now has ten women on its rolls. A southern mother who is in the automobile business is taking flying lessons in New York so that she may demonstrate the planes which she proposes to sell back home. A well known woman flyer piloted her own plane without mechanic on a lecture tour which took her to a different city nearly every night for eleven weeks.



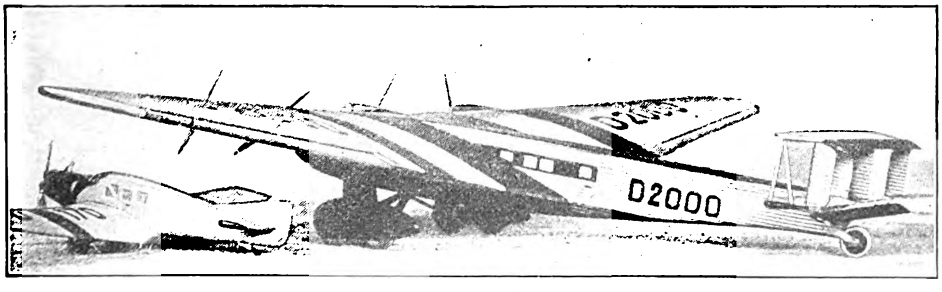
THE DO. X—TWELVE MOTORS—ONE HUNDRED PASSENGERS

This German-built flying boat (see also page 318) marks a great advance in heavier-than-air craft capable of carrying large pay-loads. The engines' total horsepower is 6300

AIR mindedness is not a slogan of propaganda; it is a fact.

But remarkable as has been the growth of flying and its ramifications, still more vital developments seem to lie just ahead. The possibilities in modifications of plane types open new and wider avenues to this latest of vehicles. Until the first of November airplanes entered in the Safe Aircraft Competition, for which 150,000 dollars in prizes is offered by the Daniel Guggenheim Fund for the Promotion of Aeronautics, will be going through their tests. Harry F. Guggenheim, President of the fund, has announced that modifications of design are in sight which may make the airplane of the near future as eaily controllable and as nearly fool-proof as the automobile.

In addition to modifications and improvements in the normal biplane and monoplane assemblies great things are expected of the development of the autogiro [*See page 290. Editor*] and the helicogyre, both types intended eventually to hover and to make perpendicular ascents and landings. The practical applications of success in this field are enormous, for with perpendicular or nearly perpendicular take-off and landing the world becomes an airport, and every roof a landing field.



TO BE A JUNKERS' PRODUCT

In the left-hand corner is a scale model of the famous transatlantic plane, the *Bremen*. The larger model, on the same scale, is of a 50-passenger plane now under construction

Then there are the new developments toward great size, chiefly in the foreign field, such as Dr. Dornier's Do. X of huge wing spread, to carry a hundred passengers and use 6300 horsepower; Herr Junker's 32-passenger sleeping-compartment plane, and Signor Caproni's 6000-horsepower biplane and 3000-horsepower monoplane, the latter fitted with pontoons, capable, according to the designer, of carrying three and one half tons from Rome to New York in 40 hours with two stops, via the Azores and Bermuda.

THESE giants are realities, flown, or soon to fly. More speculative and yet with impressive scientific endorsement are plans for planes to pierce the upper rarefied atmosphere and make speeds of many hundred miles an hour. And, within the lap of the immediate future, is the pilot guided successfully by visual radio beacons, and even the plane directed in flight by radio impulses.

The automobile conspicuously failed to displace the railroad, but has extended the variety of life beyond the dreams of its most ardent early advocate. By reason of the limitations of size, cost, and the third dimension, the airplane seems destined even more definitely to fail to displace the automobile. But one cannot watch the tremendous tempo at which aviation is expanding without realizing that, through its conquest of distance and belittling of time, through its utilization of the air roads that know no curbstones nor grade crossings, and finally, through its liberation of the human spirit, it is to have a deep and far-reaching effect upon civilization.

¶ *That well-designed airports are necessary to the growth of the aerial transport business is a truth that has become increasingly apparent in the last two years. That the problem is being attacked with characteristic big-business energy is clearly shown by the comprehensive article starting on page 298.* —The Editor.

Meteors

Most of the Meteors One Sees Are No Larger Then a Pea. The Majority Come From Far Beyond the Solar System

By HENRY NORRIS RUSSELL, Ph. D.

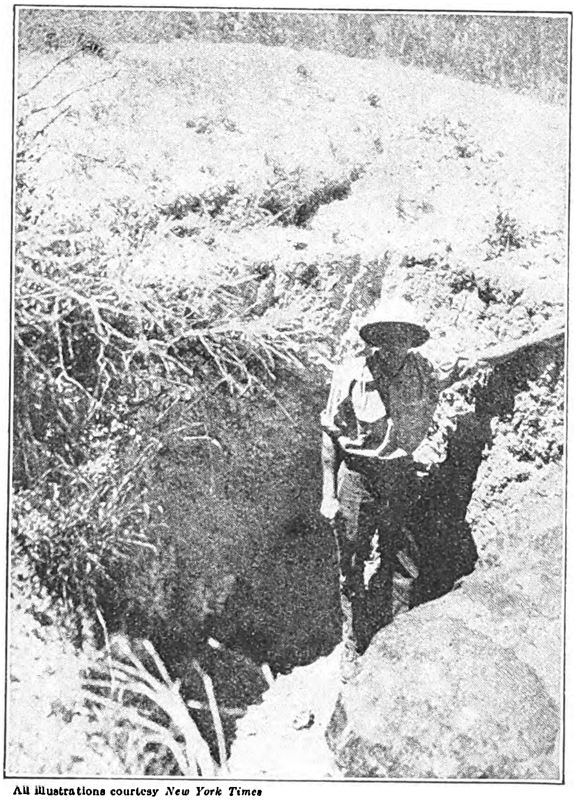
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

OF all astronomical observations the most individual are those of shooting stars. Even a total solar eclipse lasts long enough for one gazer to point things out to another, but a meteor flashes by so quickly that before a bystander can hear the words that tell of it and turn his head, it is gone. Meteors come, too, without warning, and if they were rare phenomena we would know little about them. But they are actually so common that one who watches patiently for an hour on a clear night will, on the average, see half a dozen or more. Moreover, he will not see all that appear above his horizon, however assiduous his observation, for the well-known reason that he has no eyes in the back of his head.

How many meteors would be seen if an army of observers all over the world could keep watch under cloudless skies for an hour? To answer this question we must determine whether people in different parts see the same meteors, and this takes a little planning. Two men seated side by side and watching the same part of the sky will of course see the same ones. If they are a few miles apart they can still settle the question if they have accurately synchronized watches and record the instant that each meteor is seen.

THE mere fact that both men saw the same object would be of small importance. But a great deal of information can be obtained if each observer is provided with a suitable star map and if immediately after each meteor has appeared he marks on the map its course among the stars, with the points of beginning and ending. When this is done it is found that the apparent tracks as seen by observers 10 miles or so apart are quite differently placed among the stars. This means, of course, that the meteors are near us, vastly nearer than any other bodies which the astronomer has to study. We might have guessed this, anyway, from the great velocity with which they seem to move. But observations such as have been described replace guess work with accurate knowledge.

If we have two good observations of the meteor's track among the stars by observers at known positions it is a mere matter of trigonometry to work out just what was its real track in space; when, and how high above the earth, it appeared, and where it vanished. Such calculations show that an average shooting star begins to shine at a height of about 70 miles above the earth's surface and disappears at a height of about 50 miles, after a flight which, being at an oblique angle, averages some 35 miles in length through the atmosphere.



All illustrations courtesy *New York Times*

THE GROOTFONTEIN METEORITE

Professor W. J. Luyten of Harvard, who first brought it to the attention of science, stands in the excavation

A meteor more than 200 miles away stands a poor chance of being seen, and many which are nearer may be missed. Making allowance for this, it appears that several millions of meteors must appear above the earth's surface every day, and this number would be greatly increased if account should be taken of faint meteors which are often seen by observers with the telescope. The field of view of a telescope is so limited that the actual numbers of faint meteors in the whole sky must be enormous. Professor Shapley estimates that a billion meteors, large and small, may enter the earth's atmosphere in a day.

As everyone knows, the light of a meteor is produced by the action of the upper air in slowing up the meteor's speed and converting the energy of its motion into heat. It is only after they enter the atmosphere that they shine, and the smaller ones are consumed before they get down very far. The larger masses which appear, not like flying stars but as brilliant fire balls lighting up the whole landscape, often penetrate much lower, sometimes as low as 20 or 30 miles before their speed is reduced enough to keep them from glowing.

How big are these bodies? What are they made of? And where do they come from?

THE first of these questions can be roughly answered when we know how much light they radiate, for this tells us how much energy they have had to spend in this way and their whole initial store of energy, although greater, was probably not many times greater. Knowing the initial speed—a matter to which we shall return later—it is found that ordinary bright shooting stars are in all probability only a few milligrams in weight and no bigger than fine gravel or heavy shot, while the fainter ones may be no bigger than grains of sand. The great fire balls which occasionally appear must be far larger, which is proved by the fact that some of them reach the earth as meteorites many pounds in weight while a few run up to tons.

These large masses which get into our museums and laboratories are composed of crystalline rock, of iron, or of a mixture of the two. Whether the smaller ones which are completely volatilized before they get down to the lower atmosphere are of similar composition could be determined by the spectroscope, *provided* that we had a spectroscope ready and erected at the right place and had drawn the slide of our plate holder before the meteor flashed by. This is evidently impossible to do by design, but once in a while it has happened by chance while the spectra of the stars were being photographed with an objective prism. Bright line spectra of meteors have several times been recorded, but to identify the lines is peculiarly difficult for there is usually no way of determining where to start. If we could be sure of any one line we could easily find out where the rest were, but in the absence of any such knowledge no certain solution of the problem can be made.

TWO German astronomers, Haas and Schwassmann, had the good fortune in 1924 to get a photograph of the spectrum of a meteor, and also of the trail of the meteor itself among the stars with another camera. This gave the necessary starting point and made it possible to work out the whole spectrum. The strongest lines were the familiar H and K lines of calcium in the violet, while the others were practically all due to iron which has so many strong lines in this part of the spectrum that with no dispersion they blend into fuzzy bands exactly like those observed in the meteor.

This is good direct evidence that small meteors are composed of the same familiar materials as large ones, and answers our second question—what are they made of? To attack the third—where do they come from—we must find how fast the meteors were moving when they hit the earth's atmosphere. It is well known that any particle at the earth's distance from the sun, which is moving with a speed less than 26 miles per second (relative to the sun), will be drawn by its attraction into a closed elliptic orbit, and must have followed such an orbit in the past and be a member of the solar system. But if its speed is greater than this limit its orbit must be hyperbolic and it must be a visitor from interstellar space.

When a meteor's path has been recorded by three or more competent observers in different places the actual length of its path can usually be calculated with fair precision. If we knew the time of flight with equal accuracy it would be an easy matter to find its speed compared with the earth, and then the speed relative to the sun, and so our answer. But the duration of a meteor's flight is at best but a very few seconds, and often only a second or so. If the observer had a stop watch in his hand, ready for use, it would still be difficult to get the time with any accuracy, for an error of a "split second" would be serious. But usually there is no stop watch and the statements of duration are mere estimates from memory. The late Professor C. A. Young once told the writer, "When I see a meteor I begin instantly to say

'Maria had a little lamb;
Its fleece was white as snow.'

"It takes just six seconds and a half to say the two lines, and by the word I stop on when the meteor disappears I can tell the time pretty closely. It *has* to begin with 'Maria' to make it run evenly."

This is probably as good as a stop watch!

THE estimates of velocity made in this way indicate that a large proportion of the meteors are moving in hyperbolic orbits and come from the depths of space. The well known meteor showers are, of course, an exception. These, which appear on or about the same day every year and move in parallel paths, are clearly members of our system, pursuing orbits around the sun which intersect the earth's orbit at or near a definite point.

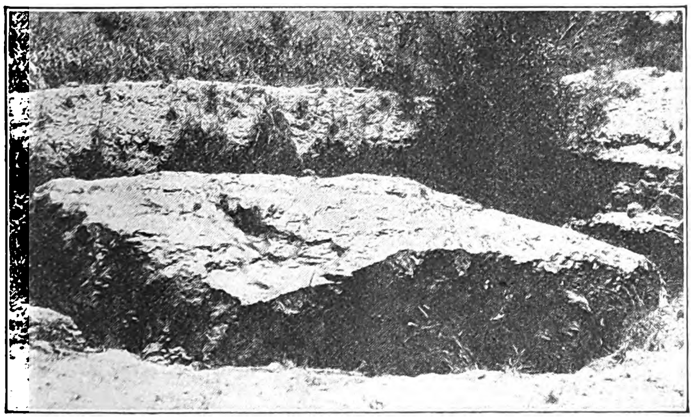
For the remaining sporadic meteors another test of origin can be made, depending, too, on the velocity but free from the difficulties just mentioned. In the evening after sunset we are on the rear of the side of the earth as regards its orbital motion, while in the morning just before dawn we are on the front. In the former case only those meteors which overtake the earth will enter her atmosphere, but in the latter we should get all those which are moving opposite to the earth, and also all those moving the same way which we overtake.

If meteors are moving in all directions but only a little faster than does the earth in its orbit, there will clearly be a great difference between the morning and evening, and we will see far more shooting stars per hour before dawn than after dark. But the higher the average speed the less this difference in number will be.

Counts of the hourly number of meteors can be made with much more accuracy than estimates of the duration of their visibility. From a long series of such counts by various observers, Hoffmeister finds strong and consistent evidence that the average velocity is high, the independent results of four series of observations giving values ranging from 42 to 46 miles per second. This is far above the limit for bodies belonging to the solar system, and indicates that a large majority of the ordinary random shooting stars which we see nightly are visitors from the depths of space.

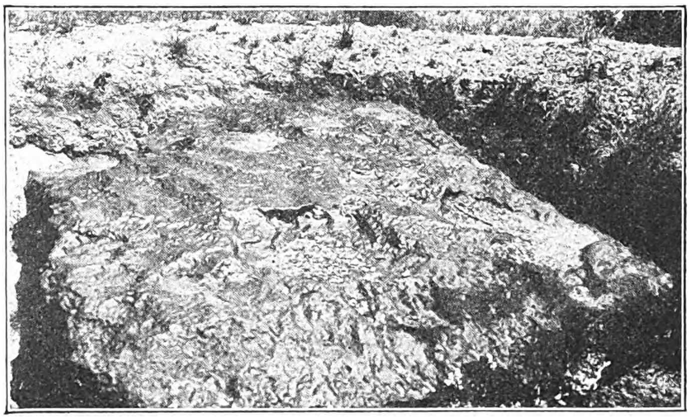
IF this is true, interstellar space is not really empty but is full of meteors. However, it is not very full, containing perhaps a speck as big as a grain of sand every hundred miles or so. The individual meteors are probably farther apart compared with their own diameters than are the individual stars.

There is more to be learned about these tiny visitors from the outposts of the universe, and this is one of the fields in which the amateur with very simple equipment can render really valuable aid to science. Only a few maps, easily acquired familiarity with the brighter stars, and enthusiasm are required. The isolated observer might have difficulty in making full use of his results, but the American Meteor Society, composed of many deeply interested observers, professional and amateur, stands ready to give help to new recruits. Those who are interested in the matter can obtain information from Prof. C. P. Olivier of the University of Pennsylvania (Philadelphia), the president of the Society and the principal American authority.



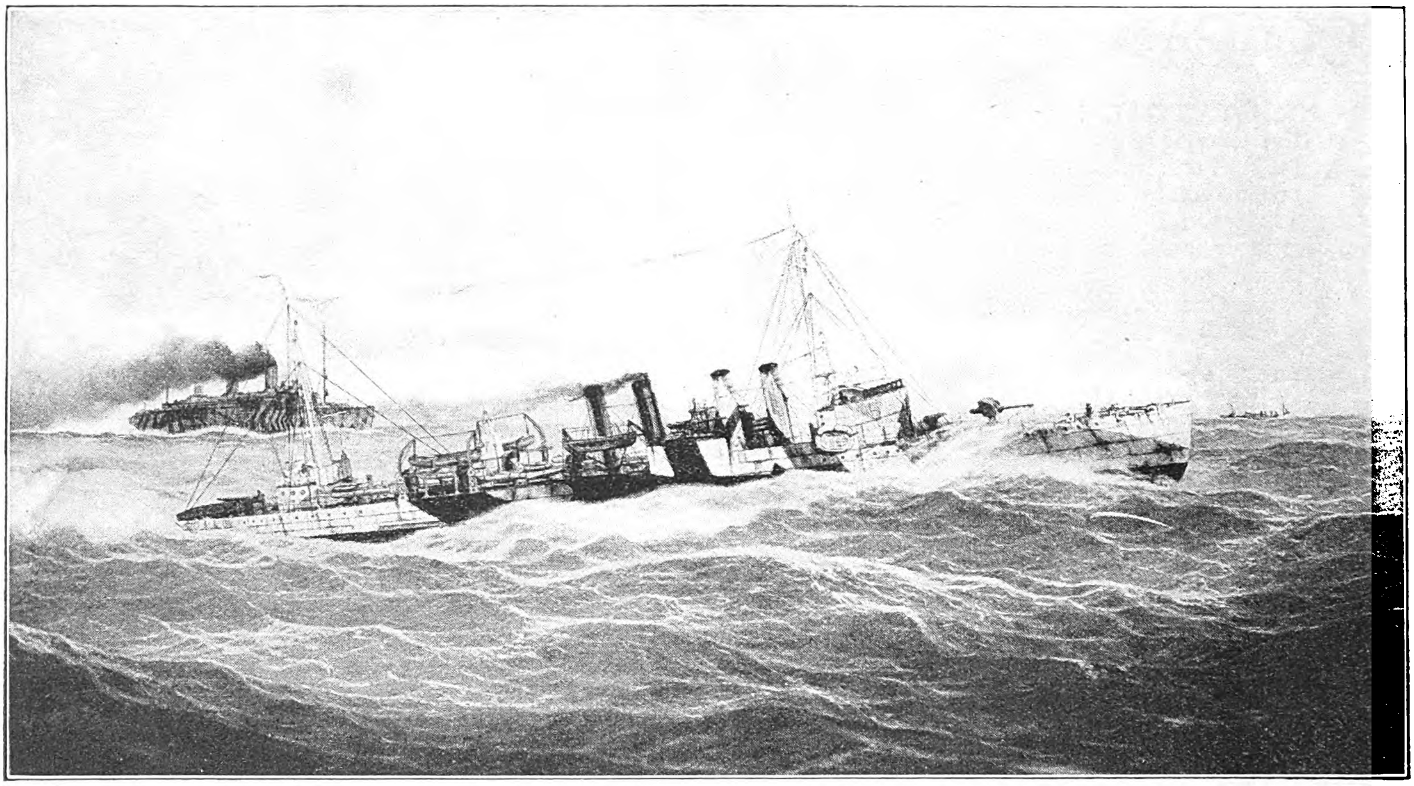
THE WORLD'S LARGEST KNOWN METEORITE

It measures nine by ten feet, is four feet thick, weighs about 70 tons (estimated), and consists of 17 percent nickel and 82 percent iron



ANOTHER VIEW OF THE SAME METEORITE

Meteorites of large size are comparatively rare, most of those that fall being tiny. Just when this particular one fell, nobody knows



SOLDIERS CROSS THE SEA IN SAFETY

In the event of war on foreign soil, our troops must be transported in numbers under warship protection. The scene above depicts the United States destroyers *Kimberly* and *Davis* escorting the transport *Leviathan* in 1918. From a painting by Burnell Poole for the Navy

Naval Reduction and Parity*

The Bearing of Past Limitations Discussions Upon Our Present Stand, and a Discussion of the Naval "Yardstick" Proposal

By CAPTAIN DUDLEY W. KNOX, U. S. N. Ret.†

THE most essential element in the perpetuation of peace is the maintenance of reasonable and adequate armaments. Next in order of importance comes limitation of these armaments. Such are the doctrines enunciated by ex-President Coolidge after an experience of nearly seven years in the White House. He also recently voiced the opinion that the essence of these problems is political, rather than technical, and that they are closely related to our very large foreign commerce and investments which "need a Navy for their protection."

Hence when we consider current trends in naval limitation we should think in terms not only of our Navy, of international relations and peace promotion, but also of our huge overseas investments and our enormous American ocean-borne commerce. The latter extends to all quarters of the globe, and every year it aggregates a monetary value nearly equal to the amount of the national debt of the United States.

The annual export of a million automobiles, and of hundreds of millions of dollars worth each of raw cotton, wheat, machinery, petroleum, and minerals, together with imports in similar proportions of silk, rubber, coffee, sugar, and many other essentials, leads us straight to terms of factories, mines, farms, and national prosperity, as an intermediate step to dealing with naval power.

AS a part of the broad picture we must also bear in mind the current large scale revival of the American merchant marine—a national "delivery service" indispensably guarding against stifling trade discrimination by competitor producer nations.

We are the world's greatest producer. Our genius for quantity production has brought us to the situation confronting England a century and a half ago, when her "industrial revolution" created a productive capacity far exceeding domestic consumption. Just as she did then so now we are actively expanding our foreign trade to prevent large scale unemployment and economic depression at home. Intensive internal development and domestic production on a vast scale is rapidly making America more and more dependent upon the sea and reviving the "sea-mindedness" which typified her

Year	United States (gross)	United Kingdom (net)	Year	United States (gross)	United Kingdom (net)
1925	$1,329,900,000	$480,500,000	1927	$1,553,000,000	$743,500,000
1926	1,318,500,000	593,150,000	1928	1,448,000,000	768,300,000

Reproduced from *Commerce Reports*, United States Department of Commerce

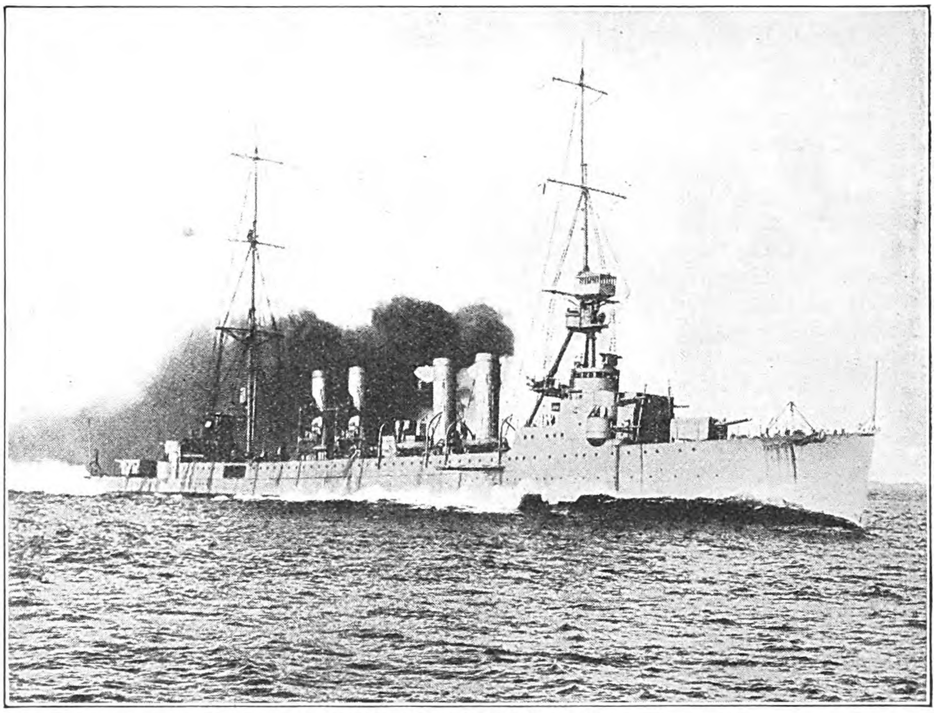
FOREIGN "INTERESTS" THAT NEED PROTECTION: LOANS

In foreign loans, the United States leads Great Britain by a good margin. To maintain peace so that these loans are safe, it is essential that an agreement as to parity be reached

---

*For a technical discussion of bases, ships, and personnel, see "Naval Adequacy," parts I to V, by Captain N. H. Goss, SCIENTIFIC AMERICAN, October 1928 through January 1929.

†See "Among Our Contributors," page 279.



A BONE OF CONTENTION

The United States cruiser *Richmond*, one of a type that caused the failure of the 1927 Conference. Now, however, a ray of hope for agreement on this type—and others—is seen

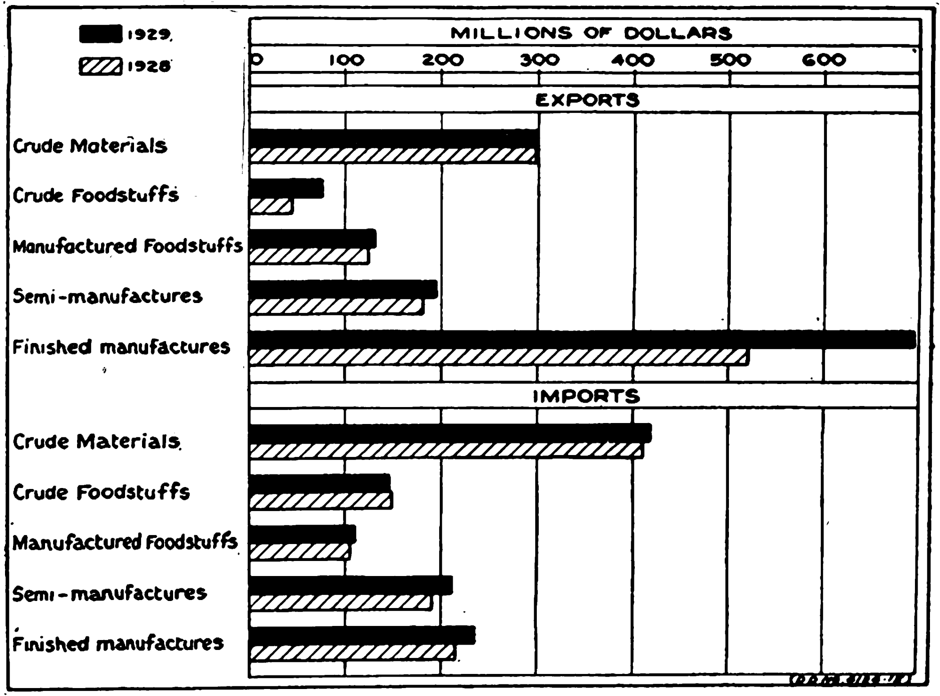
a century ago. Thus it is that the broadest cross-section of national economics and prosperity is intimately related to the question of limitation of naval armaments—for the United States no less than for European countries.

Here, then, is the real background for the various steps which have been taken toward limiting naval forces, from the almost barren efforts initiated by Russia in 1898, through the series of fruitless proposals for a naval holiday made by the British just before the World War, until the partial success of the Washington Conference of 1921-22, and finally to the recent olive branch held out by Mr. Gibson, our "observer" at the last session of the League's Preparatory Commission on Disarmament.

DEVELOPMENTS anent the naval question have been coming so fast that it was impossible to include the very latest news in this article. Shortly before this page went to press, Premier MacDonald of England, as a gesture of good will toward America, halted construction on two British cruisers and slowed down other naval work. President Hoover, who had just proclaimed the Kellogg Pact before representatives of signatory nations, answered this *beau geste* by suspending construction on three American cruisers on this year's program. It is expected that these acts will have a direct influence upon the final agreement for parity.—*The Editor*

The first genuine progress in limitation of naval armaments was made at the Washington Conference where an agreement was reached by the five leading naval powers fixing a proportion of relative strength between them and maximum quotas for capital ships and airplane carriers. An upper limit for the size of individual ships and of their guns was also agreed to, not only for capital ships but also for cruisers.

But, unfortunately, no agreement could be reached as to a limit upon the total number or aggregate tonnage of cruisers, nor upon other smaller fleet auxiliaries such as destroyers and submarines. This was a serious defect in the treaty since it invalidated the principle of limitation by leaving open the way to future competition and swollen armaments in the cruiser and other auxiliary classes. Carried too far, new construction in these classes could very substantially alter the theoretical relative strength between the various navies, as it has actually done since 1922.



Reproduced from *Commerce Reports*, United States Department of Commerce

OUR OCEANBORNE COMMERCE

Our imports and exports are steadily mounting, as may be seen by a comparison of these figures. International naval accord would serve as a measure of commerce protection

THIS matter assumes great importance from the view-point of trade protection, and hence of national economics. Indispensable as battleships may be in the complex structure of sea power, they are but one of the various means which have the common end in view of protecting sea communications.

Insecure national trade means insecure national business and peace. Herein lies the explanation why such a peace-loving and economy-minded President as Mr. Coolidge vigorously contended for a great and costly cruiser program. Soon after the Washington Conference, other naval powers embarked on large construction programs for types of vessels which had not been included in the limitation agreements. We refrained, feeling that, regardless of the letter of the treaty, its spirit was against substantial addition to our fleet in any class of ship. Our position was made all the more remarkable by the fact that, in 1922, we had been very deficient in trade-protecting cruisers, as compared with other powers, and our offer to scrap preponderant battleship strength, which they accepted, had been conditioned upon their placing a limit on cruisers and other auxiliaries, which they rejected.

We were thus confronted with an urgent need either of bringing about an international limitation on naval auxiliaries, efforts toward which had failed at Washington, or entering the new competition by undertaking large new construction. In these circumstances President Coolidge called the Geneva Conference of 1927, the invitation to which was accepted only by Great Britain and Japan.

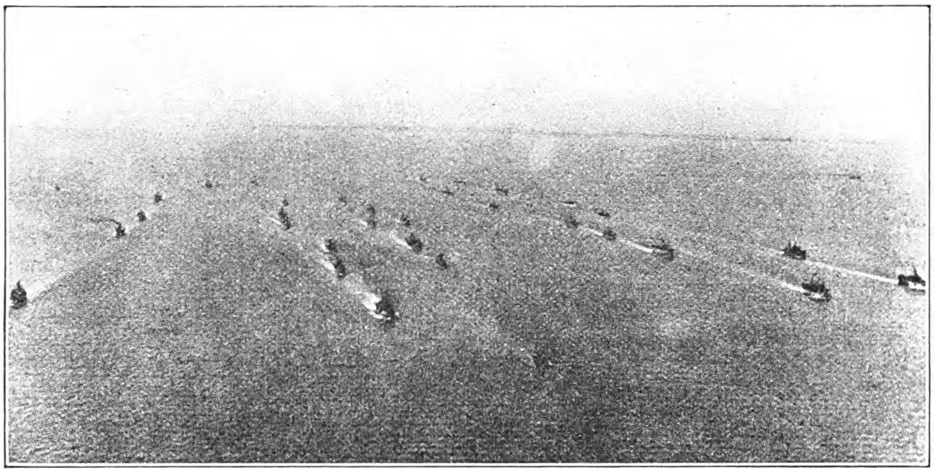
THERE the failure to reach agreement revolved about trade protection ability. We proposed to restrict the cruiser quota for Great Britain and America to 250,000 or 300,000 tons each. Britain maintained that nearly twice such a limit was necessary for the protection of her ocean trade. She was finally willing to reduce the allotment to about 425,000 tons provided the size of individual cruisers was also substantially reduced, so that the number of cruisers which she regarded as essential to trade protection could be provided.

Equally solicitous for the protection of an American ocean commerce of virtually the same amount as the British, our delegation insisted upon the right to build large cruisers, even though this would mean a greater restriction in the numbers of ships which we could build under a total tonnage quota.

This was the crux of the failure of the tri-partite naval conference at Geneva in 1927, held at the instigation of President Coolidge, following which he came out so strongly for a substantial American naval auxiliary building program.

Meantime American technicians have been at work attempting to devise a basis upon which the inherent differences between the United States and Great Britain might be reconciled on the question of a limitation agreement respecting cruisers. The American position heretofore has been that each country should be allowed to build the type of cruiser best suited to its own needs. For example, under a total tonnage allowance of 240,000, the United States could build 24 of the 10,000-ton individual size, and the British 40 cruisers with a displacement of 6000 tons each.

Such a solution would offer advantages and disadvantages to both sides which would practically balance each other. In a stand-up fight between the two cruiser forces acting alone—a highly improbable situation both tactically and politically—the American force of a relatively small number of large units would unquestionably be more than a match for their more numerous but smaller opponents. The American force of large size, individual cruisers would also have an advantage for purely defensive commerce protection.



A RARE WAR-TIME PHOTOGRAPH

An airplane view of a convoy of merchant ships during the late war. An escorting cruiser may be seen in the foreground and other small escort vessels are shown far out on the flanks

On the other hand the cruiser force consisting of numerous small units would be considerably superior in the ability to raid commerce—immensely so when complemented by such a wonderful system of world-wide naval bases as the British possess. This follows by reason of the greater dispersion possible for the larger number of units, and the greater proportion of time which they can spend in fruitful raiding areas, because of the supplies and protection afforded by nearby bases. Thus it is apparent that, contrary to what is commonly understood, in contending for a small number of large cruisers the Americans have been seeking commerce-protecting ability, as opposed to the commerce-raiding potentialities of the British side of the case.

THE foregoing illustrates the principles involved in a total tonnage system of measuring naval strength, which was the basis used at the Washington Conference, and adhered to by the American Delegation at Geneva in 1927. The theory is that it leaves each nation free, within certain outside limits, to vary the details of man-of-war design. Those who prefer high speed, or more armor, or great cruising radius, or heavy gun power, may incorporate their preference in the design, sacrificing other qualities as necessary to keep within the maximum individual size and the total tonnage allowance. In the long run, the advantages and disadvantages will more nearly balance each other by tonnage comparison than by any other yardstick. Such has been the opinion of the best technicians on both sides of the Atlantic for many years. No one has sustained this viewpoint more emphatically than Admiral Jellico, of England, who is certainly one of the best authorities.

THEREFORE when Mr. Gibson reopened the cruiser question at Geneva last April, with references to a formula for reconciling American-British differences, the implication was that at least for cruisers we were willing to accept some other standard of measurement than tonnage and to concede something in line with the previous British position. He stressed that an agreement was more important than a method. Nevertheless he made it very clear that any concession which we might make with respect to method was conditioned upon meeting us at other points.

First of all he insisted that any new agreement should constitute an actual reduction of existing or projected armaments. This appeared to have reference to our stand at Geneva in 1927 for a cruiser quota of about half what the British wished. The quota proposed by them would have been a substantial increase over the *status quo*. Mr. Gibson also emphasized that any future agreement must include all types of naval vessels, meaning that we should not repeat the mistake made at the Washington Conference of leaving the door open for future competition on a large scale and thus upsetting the relative strength of total naval power between the respective countries. A third point was that the ratio of total strength should remain as agreed to at Washington: 5-5-3.

Mr. Gibson's olive branch was well received in all quarters. It appears to constitute an important step in the progress of naval limitation. His detailed plan was presented to the other powers who undertook to study it. Whether or not it has any immediate effects, which the subsequent adjournment of the League's Preparatory Commission on Disarmament seems to make doubtful, it constitutes a preliminary to the conference scheduled to meet at Washington in 1931 under the terms of the agreements reached at the last Washington Conference.

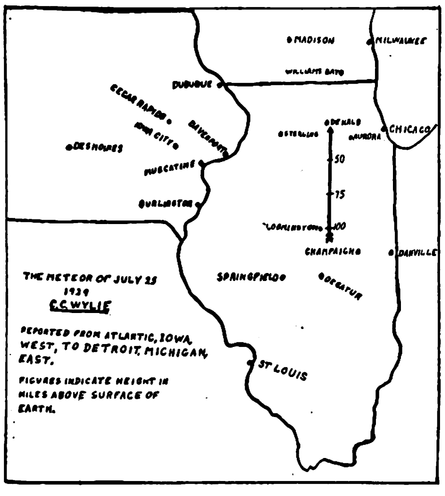
A Large Meteor Falls

By **PROFESSOR C. C. WYLIE**
Department of Astronomy, University of Iowa

"WELL, we have company," remarked my assistant. Glancing up from the telescope, I saw a young doctor from the near-by hospital, dressed in white, standing quietly in the door of the room of the observatory in which we were working. He waited until we had finished that observation, and then asked, "Did you see the meteor a few minutes ago, Professor?" This was our first intimation of the brilliant meteor which fell about 9:45 P.M., Central Standard Time, on the evening of July 25, 1929.

At Atlantic, Iowa, more than 300 miles west of the path, it was described as a "long, fiery-tailed comet." At Des Moines, 250 miles west, the account read, "as bright as the sun." At Iowa City, 150 miles west, several noticed it from lighted rooms. At Burlington, 125 miles west, people telephoned the local airport that an airplane had dropped flares, so the signal light and flood lights were turned on. At Milwaukee, 100 miles north, the coast guard reported seeing a "flaming airplane diving into the lake," and 20 miles west of Milwaukee the report was that it "illuminated the countryside until it was almost as bright as day." Closer to the path we find that for Peoria, headlines announce the "meteor turned night into day;" and at Williams Bay, Wisconsin, a group watching a thunderstorm saw "a bright light of yellowish cast coming straight toward them from the south . . . So directly was it coming that they felt they should dodge." To the east it was reported as far as Detroit.

Most people who saw the meteor had their attention attracted by its illumination of surrounding objects. They saw "the surrounding darkness burst into brilliant light." At the distance of Iowa City, the illumination was compared to—"a flash of green lightning, except that it lasted longer;" "the lights of a parked car suddenly turned on the automobile in which you are riding;" or "an airplane signal light sweeping by."



THE METEOR'S FLIGHT
A sketch by the author. The altitude of its disappearance was about 25 miles

We astronomers located at the University of Iowa, Iowa City, did not notice the meteor, as the slit of our observatory was open in another direction, and the light from passing cars occasionally sweeping over the slit made it unlikely that an illumination, unless even greater than that from this meteor, would attract attention when we were working. From the description of the young doctor, Edward Evert Hale, it was apparent that an important meteor had flashed down a hundred miles or more to the east of us, so steps were at once taken to secure the information necessary for computation of its path through the atmosphere. An announcement was placed in the local morning paper; requests for information were sent out by the university news service, and broadcast from the university radio station.

LOCAL people who had seen the meteor were interviewed, as far as possible, at the exact spot from which they had viewed the fall. If inside a building, measurements were taken to secure as accurately as possible the direction and apparent height of the place where the meteor was first seen, and of the point of disappearance. If seen from outdoors, a pocket transit was usually preferable. Engineers apply to this little instrument the rather uncomplimentary term "guessing machine," but the angles for the points of appearance and disappearance can be read more accurately than people can remember the position.

By similar interviews, Father Theobald, of Columbia College, Dubuque, secured the angles for points of appearance and disappearance as seen from that city; and two days after the event, sufficient information was at hand for a preliminary computation of the path of the meteor through the atmosphere, the result obtained being only slightly different from that given by the more complete information a week later.

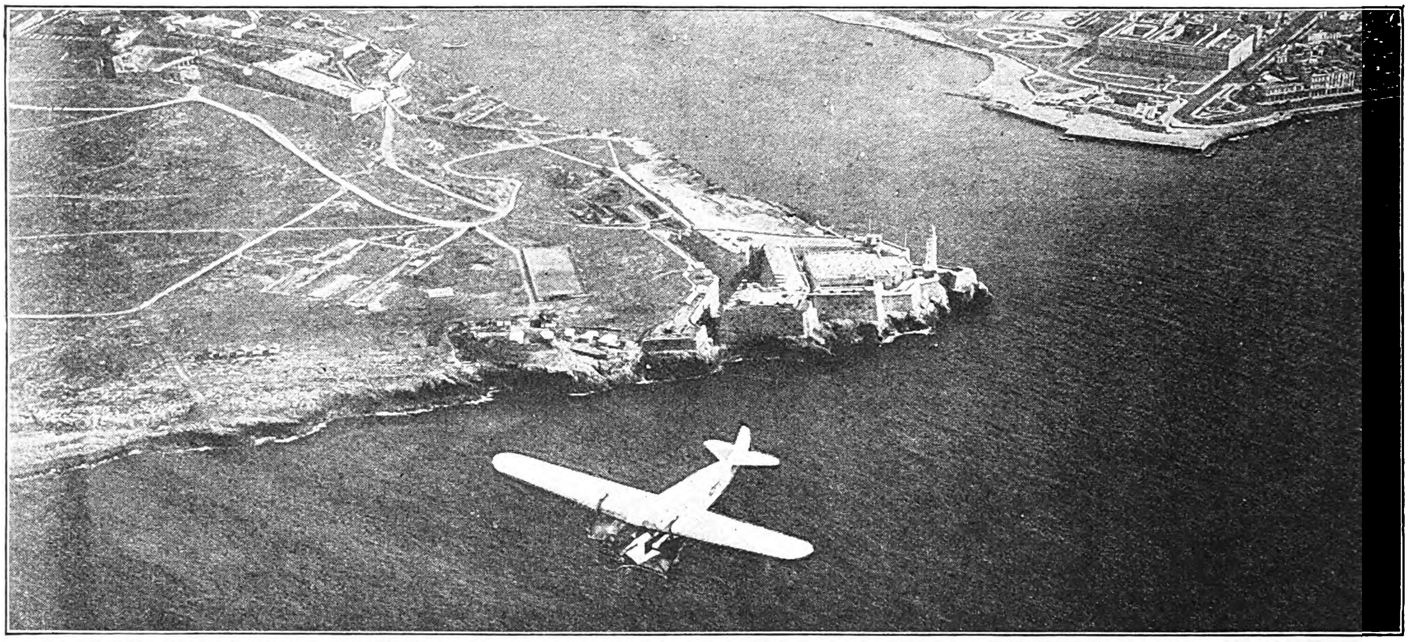
The arrow on the accompanying map shows the path of this celestial visitor as it came down over the state of Illinois. It became bright enough to attract attention at a height of slightly more than 100 miles over a point near Bloomington, Illinois, dropped down and to the north, rapidly increasing in brightness, and disappeared at a height of about 25 miles over a point near De Kalb.

USING THE POCKET TRANSIT
The author reading the angles for the points of appearance and disappearance

Whether any meteorites actually reached the earth we can not say when this is written (August 6). Probably we will never know. The fact that thunderstorms were in progress in the vicinity of De Kalb makes information from that critical point difficult to secure. Large meteors usually burst and disappear at a height of 15 or 20 miles. The meteorites, contrary to popular opinion, fall the remaining distance as dark objects, and are invisible at night and difficult to see unless very close, even in daylight. The sound of the falling stones is useful in directing a search.

We assume that many readers will want to know the kind of information which the astronomer studying meteors appreciates receiving. Almost any accurate information is of value: brightness, color, illumination of landscape, duration of visibility, time of occurrence, apparent direction of motion, possible sounds, and apparent nearness. But the information which will probably help the most, because it is hard to get, is the direction and apparent altitude of the points of appearance and disappearance. This can be ascertained quite simply.

The most accurate way to send this information is, of course, simply to send a plot of the path on a star chart; but this is usually not possible. A simple and reasonably accurate method is to lay a yard stick pointing in the direction where the meteor was last seen. Then measure the number of inches the east end is north or south of the west end of the stick; or the number of inches the north end is east or west of the south end.



THREE-MOTORED PLANE OF THE PAN AMERICAN AIRWAYS OVER BEAUTIFUL HAVANA HARBOR, EN ROUTE FOR MIAMI

American Passenger Air Transport

The Passenger-carrying Airlines of the United States Have Shown Remarkable Growth in the Last Two Years

By PROF. ALEXANDER KLEMIN
Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, Scientific American

UNTIL quite recently there has been a general impression in the public mind that we were lagging behind Europe in commercial aviation. As a matter of fact, we have always led the way in the industrial applications of the airplane, such as aerial surveying, aerial photography, cotton dusting, forest fire patrol, and so forth. In regular flying mileage, in airmail and express matter carried, we have led every European country for many years. In private ownership of planes, for such purposes as the inspection of ranches, sales and advertising, inspection trips by executives of large business houses, the United States is also well in the lead. It is only in the carrying of passengers by air that we have lagged behind.

There are very definite reasons why this has been the case. In the first place, Europeans received during the war more lessons in the use of the airplane as a vehicle of transportation than we did. Staff officers, government officials, even prime ministers, on occasion found traveling by air the most expeditious method, and knowledge of such travel naturally spread among the general European public.

The airplane proved itself a tremendously powerful instrument of warfare, and European governments were willing and anxious to encourage airlines for strategic reasons, giving generous subsidies for the carrying of passengers. The carriage of mail and express is more profitable for aircraft, just as for railroads, than passenger work and before the costs of airplane operation were reduced, it was quite impossible for our unsubsidized air lines to carry passengers. With subsidies to help them, European operators were able to carry passengers by air at little greater fares than by the best train or boat accommodation. Hence the European operators got a head start and ten years steady and, on the whole, safe and regular passenger operation, widely advertised, have given their lines a great reputation.

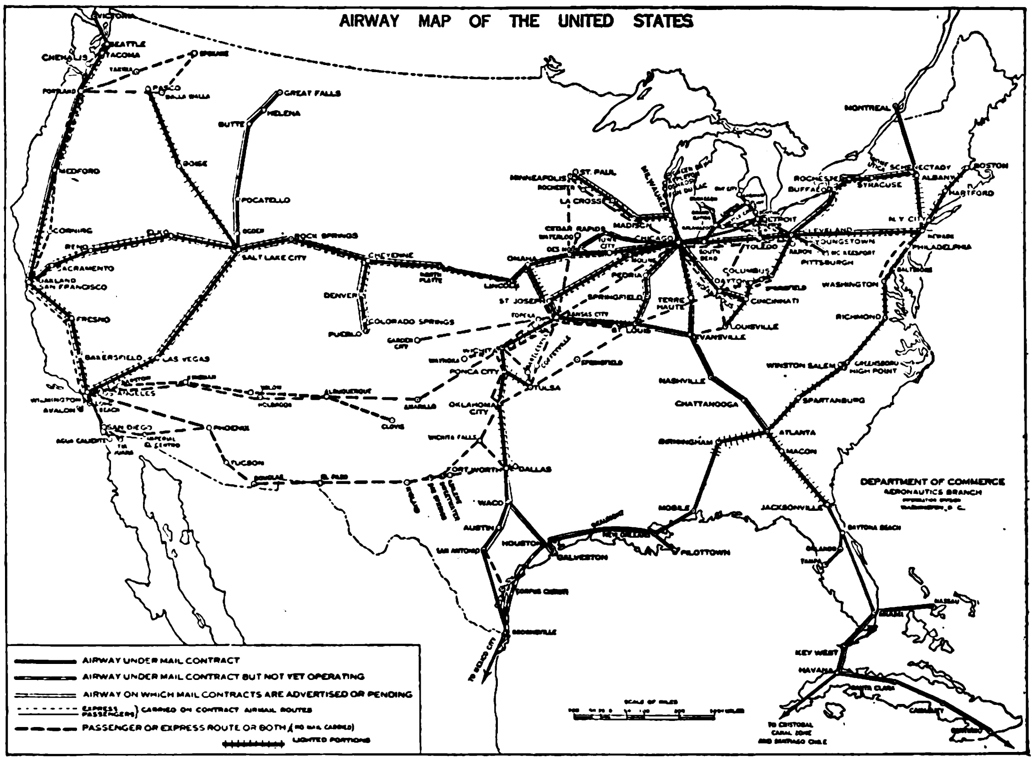
GOVERNMENT regulation came earlier in Europe, so that airplane safety made more rapid strides than in America. And safety and comfort are even more important to the traveling public than expense.

Unusually favorable geographic conditions are found on certain European lines. Thus, the seven- or eight-hour journey between London and Paris meant changing from train to boat, a possibly choppy and unpleasant channel crossing, and a dreadful half hour in getting through the French customs before boarding another train. The two-and-a-half-hour flight from Croydon to Le Bourget certainly avoided most of these discomforts. Customs barriers, geographic conditions, and poor train service all helped to make the airplane popular among European travelers.

Besides, Europe had the enormous advantage of great numbers of American tourists. Business men, who, when in the United States, expect trains to run with clockwork regularity, are perfectly willing on a vacation tour to take an air trip, in which there is chance of turning back due to fog, or of a forced landing far from a railway station. It is no exaggeration to to say that in the summer months more Americans than Europeans travel on foreign lines.

With no subsidies, no government regulation, and no tourists, American operators naturally hesitated to enter the field of passenger air transport. Their position was accurately and vividly expressed by C. S. ("Casey") Jones of the Transcontinental Air Transport, speaking recently before the Chamber of Commerce of the United States.

"There are a number of reasons why the operator hesitates to go into the carrying of passengers. From his standpoint, it is much more economical and better to carry mail or express. I have seen mail planes come in with a full load of mail in them, in fact, so full that it has been necessary to tie two or three sacks around the engine. If you are carrying some nice old lady passenger, it is kind of hard to think of her tied around the engine. In other words, in carrying passengers, we have to look to their safety, we have to overcome the natural fear of traveling by air. Then we have to take care of the insurance and the liability. So you can see why the American operators, having to put their lines on a commercial paying basis, have been slow in going into passenger transportation. Now that the through lines carrying mail and express are in the black figures, American business men are investigating and starting to run passenger lines.


AIRWAY MAP OF THE UNITED STATES
SEATTLE
TACOMA
SPOKANE
PORTLAND
MEDFORD
GREAT FALLS
HELENA
BUTTE
BOISE
POCATELLO
RENO
SACRAMENTO
SAN FRANCISCO
FRESNO
BAKERSFIELD
LAS VEGAS
SALT LAKE CITY
ROCK SPRINGS
CHEYENNE
NORTH PLATTE
DENVER
COLORADO SPRINGS
PUEBLO
OMAHA
LINCOLN
ST. JOSEPH
MINNEAPOLIS
ST. PAUL
LA CROSSE
CHICAGO
DETROIT
TOLEDO
CLEVELAND
YOUNGSTOWN
PITTSBURGH
COLUMBUS
CINCINNATI
LOUISVILLE
EVANSVILLE
TERRE HAUTE
SPRINGFIELD
ST. LOUIS
KANSAS CITY
TULSA
OKLAHOMA CITY
WICHITA FALLS
FORT WORTH
DALLAS
WACO
AUSTIN
SAN ANTONIO
HOUSTON
GALVESTON
BROWNSVILLE
NASHVILLE
CHATTANOOGA
BIRMINGHAM
ATLANTA
SPARTANBURG
MACON
MOBILE
NEW ORLEANS
PILOTTOWN
JACKSONVILLE
DAYTONA BEACH
MIAMI
KEY WEST
HAVANA
NASSAU
RICHMOND
WASHINGTON
PHILADELPHIA
N.Y. CITY
NEWARK
HARTFORD
BOSTON
ALBANY
SCHENECTADY
SYRACUSE
ROCHESTER
BUFFALO
MONTREAL
WINSTON SALEM
GREENSBORO
HIGH POINT
LOS ANGELES
SAN DIEGO
PHOENIX
TUCSON
EL PASO
DEPARTMENT OF COMMERCE
AERONAUTICS BRANCH
WASHINGTON, D.C.
AIRWAY UNDER MAIL CONTRACT
AIRWAY UNDER MAIL CONTRACT BUT NOT YET OPERATING
AIRWAY ON WHICH MAIL CONTRACTS ARE ADVERTISED OR PENDING
EXPRESS / PASSENGERS } CARRIED ON CONTRACT AIRMAIL ROUTES
PASSENGER OR EXPRESS ROUTE OR BOTH (NO MAIL CARRIED)
LIGHTED PORTIONS

From Air Commerce Bulletin

LATEST OFFICIAL AIRWAY MAP OF THE UNITED STATES

"WE do not know how they are going or whether they are going to pay. We are very sure it is going to take a number of years to make them pay.

"We believe that American aviation has now overcome the various handicaps, that the period of hesitation has passed, and that passenger carrying which has advanced so rapidly in the last two years, will advance even more rapidly in the near future."

Passenger services are new, and the statistical machinery is only now beginning to get organized. In considering passenger airlines, it is better to rely on figures for the last two years only.

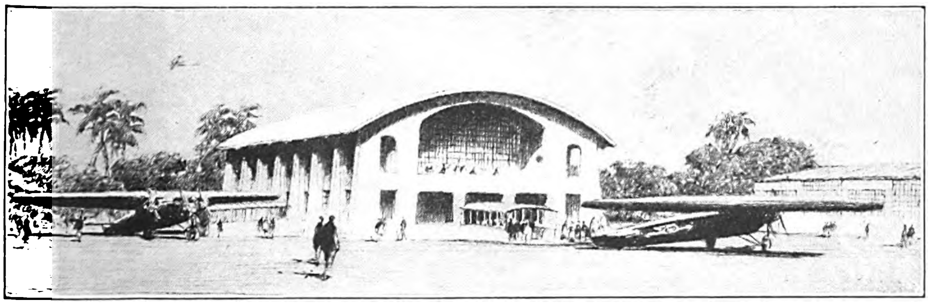
In 1927, 12,594 passengers were flown on scheduled, regularly operated services. In 1928, they numbered 52,934. It is a fair guess to say that this number will be tripled or quadrupled in 1929.

Government publications notwithstanding, nothing can give us as vivid a picture of the present status of American passenger service as the consolidated time-tables issued by the American Air Transport Association, and the Fletcher Official Aviation Guide. (The Fletcher publication is much more complete as it is not restricted to members of the Association.)

If we are to believe the Official Aviation Guide there are now 44 companies giving passenger service. Space permits us to list only the airways specializing in passenger service and we refer our readers to the guide for detailed information.

Colonial Air Transport, New York-Boston; *Colonial Western Airways*, Albany-Cleveland; *Colonial Western*, Buffalo-Toronto; *Middle States Air Lines*, Akron-Detroit; *Canadian Colonial Airways*, New York-Montreal; *United States Air Transport*, New York-Washington; *Clifford Ball*, Cleveland-Pittsburgh; *Capital Airways*, Indianapolis-Detroit; *Midwest Airways*, Watertown-Des Moines; *Coastal Airways*, New York-Albany; *Northwest Airways*, Chicago-Green Bay; *United States Airways*, Kansas City-Denver; *Rapid Air Lines*, Watertown-Rapid City; *Yellow Cab Airways*, Kansas City-Twin Cities; *Scenic Airways*, Grand Canyon Scenic Airways; *Universal Aviation Corp.*, New York-Los Angeles; New York-Oklahoma City; St. Louis-Los Angeles; New York-Denver; Chicago-St. Louis; St. Louis-Omaha; Tulsa-Fort Worth; Cleveland-Louisville; Tulsa-San Angelo; Kansas City-Oklahoma City; *Embry-Riddle*, Chicago-Cincinnati; *Texeco Air Transport*, Dallas-El Paso; Fort Worth-San Antonio; Fort Worth-Galveston; *Standard Air Lines*, Los Angeles-El Paso; *Boeing Air Transport*, Salt Lake City-San Francisco; *Pacific Air Transport*, Seattle-Los Angeles; *Western Air Express*, Los Angeles-Salt Lake City; Cheyenne-Pueblo; Los Angeles-Kansas City; *Maddux Air Lines*, Los Angeles-San Francisco; *Transcontinental Air Transport*, New York-Los Angeles; *National Parks Airways*, Salt Lake City-Great Falls; *Pan American Airways*, described below.

We have listed all the air routes we could find which make a specialty of carrying passengers. But prospective air travelers will do well to study maps and time-tables to determine whether a given line carries mail and passengers or passengers alone.



THE BEAUTIFUL PASSENGER DEPOT OF THE PAN AMERICAN AIRWAYS AT MIAMI

THOSE lines which specialize in passenger carrying provide the maximum comfort and convenience. On lines carrying mail and passengers, particularly when employing single-engine planes, passengers cannot be sure of accommodations as the post-office requires that mail be carried in preference. Comfort is apt to be sacrificed to speed. Weather which would keep a passenger plane back is apt to be disregarded. Of course, this condition is rapidly improving, as operators find they can put on special planes for passengers alone.

It is often said "Once a railroad man, always a railroad man." There seems to be a peculiar fascination about railroad work which will maintain a man's interest for a life time. We venture to say that the work of the air transport operator will be even more interesting. Air transport operation certainly involves a greater variety of problems and conditions.

Colonial Air Transport, with General J. F. O'Ryan as executive head, for example, has attempted the task of connecting two great cities, New York and Boston, by passenger air service, in the face of competition by splendid five-hour trains, running from the heart of one city to the center of the other.

WESTERN AIR EXPRESS
113 West 9th Street, Los Angeles, Calif.

KANSAS CITY-LOS ANGELES

WESTBOUND Read Down	Twelve-Passenger, Multi-Motored Cabin Planes	EASTBOUND Read Up

Daily	Miles	TABLE 51 Standard Time	Daily
8.30 AM	0	Lv **Kansas City**....(C.T.) Ar	9.10 PM
10.20 AM	216	Lv Wichita......... " Lv	7.50 PM
1.55 PM	597	Lv Amarillo........ " Lv	5.00 PM
3.55 PM	810	Lv Albuquerque....(M.T.) Lv	1.00 PM
5.58 PM	1026	Lv Holbrook........ " Lv	10.40 AM
7.35 PM	1201	Lv Kingman........(P.T.) Lv	7.30 AM
9.35 PM	1417	Ar **Los Angeles**.... " Lv	5.00 AM

This service connects at Kansas City with rail lines oporating to and from Chicago, St. Louis and the East.

PASSENGER FARES

One-Way Between	Los Angeles	Kingman	Holbrook	Albuquerque	Amarillo	Wichita
Kingman	$35.00	......	......	......	......	......
Holbrook	65.00	$30.00	......	......	......	......
Albuquerque	90.00	55.00	$25.00	......	......	......
Amarillo	120.00	85.00	60.00	$35.00	......	......
Wichita	155 00	120.00	95.00	75.00	$35.00	......
Kansas City	175.00	145.00	115.00	95.00	60.00	$25.00

A TYPICAL AVIATION TIME-TABLE

They arranged for a bus to leave the Hotel Pennsylvania 45 minutes before plane time at the airport in Newark, and another bus from the Statler Hotel in Boston, 35 minutes before plane time. With 1 hour and 45 minutes in the air, this made the total journey approximately 3 hours and 5 minutes long, giving an appreciable saving of time. There are two schedules a day, so that a business man can pay a visit to his office in New York, do a fair morning's work, and still get to Boston in time to spend a busy afternoon there. A Bostonian, on the other hand, who comes into New York for a whole business day, can leave late in the afternoon and get home in time for dinner.

PEOPLE have talked a great deal about the inability of the airplane to meet train competition on short hauls. Yet during the first month of operation, ending May 15, Colonial carried 533 passengers on 87 trips, an average of 6.1 passengers (50 percent capacity) per trip. The single trip fare of $34.85 is nearly three times as much as train and Pullman, but cheaper commutation tickets seemed to meet this difficulty, and 350 commutation passages were sold in the first few weeks of operation.

Pan American Airways offer a service from Miami to Havana, 261 miles flown in two and a quarter hours. Because at the time this service was inaugurated, no flying boats of sufficient size and speed were available, Pan American put into service large three-engined Fokker planes, equipping them with flotation gear to guard against emergency landings in the Gulf.

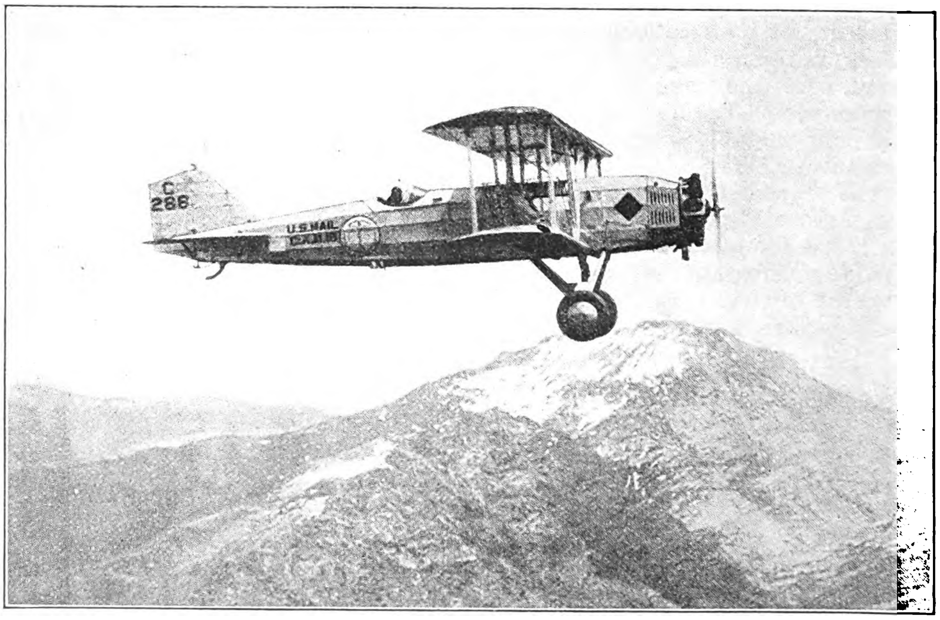
The same company connects Miami with Havana, Camaguey, Santiago, Porto Prince, and San Juan, Porto Rico. Eight passenger amphibians give service between Miami and Nassau. To meet the needs of a Spanish speaking population in Cuba, Pan American provide comprehensive pamphlets printed in this language.

Florida and Havana are the lands of vacation. The company undoubtedly secured the services of a practical poet to write their leaflets. "All mail, luggage, and passengers are weighed, and a safety margin of 20 percent in lifting power is rigidly maintained." "Through rail-air service from every prominent city in the United States makes it possible to travel in unbroken ease and luxury all the way from your home to the Indies." There speaks the practical man. Now the poet: "Magic Sails;" "South with the Birds;" "Over the Violet Sea;" "Speeding to Happiness;" "Gay tropical colors surround him, brightening the roomy cabin with its comfortable wicker seats;" "Having dodged the tedious hours of choppy sea, the traveler arrives fresh and rested, ready for work or play."

The Pan American terminal at Miami deserves particular notice. The first floor is furnished as a lounge and waiting room of the utmost comfort, divided and equipped in such a manner that the baggage and customs are taken care of with the least annoyance. A mezzanine encircles the entire building and provides a splendid observation lounge, various large dining rooms, and so forth.

ANOTHER line which has achieved much prestige and distinction is the Western Air Express, with its three long lines radiating from Los Angeles to Salt Lake City, San Francisco, and Kansas City, a short line between Pueblo, Denver, and Cheyenne, and a sight-seeing service from Los Angeles to Catalina. Meeting the varying needs of these lines, tri-motored Fokkers are used on the main lines, a single-engined Stearman between Pueblo and Cheyenne, and a Sikorsky amphibian to Catalina Island.

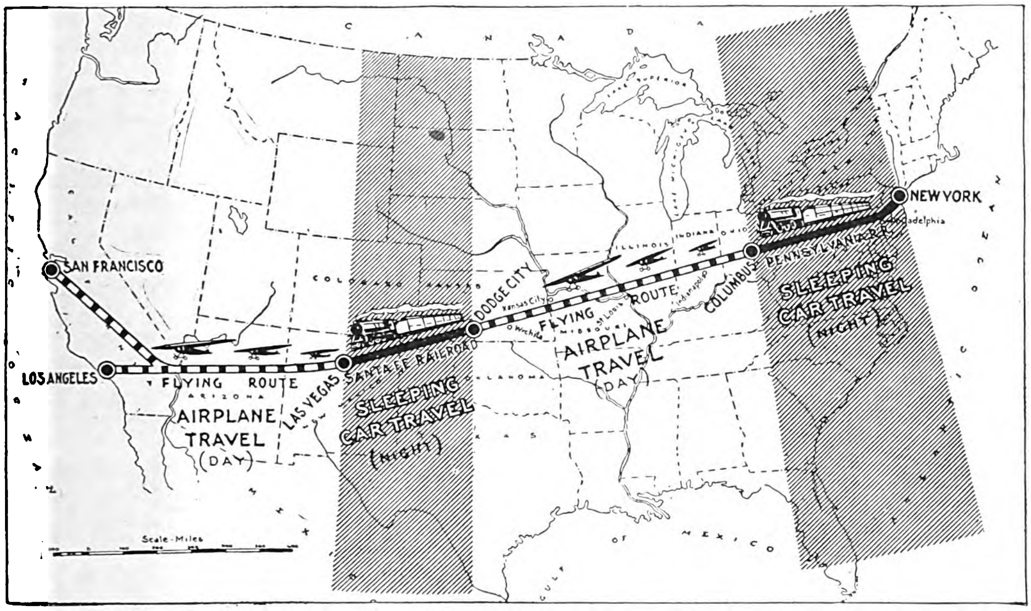
The president of this line, Harris M. Hanshue, has gained distinction because he was perhaps the first man to make an airline pay and because of the splendid organization of Western Air Express, modeled precisely on that of a railroad. Under him are two vice-presidents, one in charge of operations, the other in charge of traffic. Secondary in the operations department comes the superintendent of operation, who has general supervision over all fields used by the company, then a field superintendent for each field, a master mechanic, mechanics, and pilots. Secondary in the traffic department come the general traffic manager, general passenger agent, passenger agents, and division managers at each terminal. There is also a department handling publicity and public relations.



BOEING MAIL AND PASSENGER PLANE

This type of airplane is being used with great success between Chicago and San Francisco, and between Los Angeles and Seattle. It can transport a useful (pay) load of 2523 pounds

Throughout the entire Western organization the rule is enforced that "Oral orders don't go." Everything is in writing. Every plane is carefully examined after every flight, by two mechanics, each of whom makes a written report. After every 200 hours of flying all motors are thoroughly overhauled.



The Original T.A.T. Route; See Text for New Route

Another very important and successful transport system is the Boeing. While hitherto the Boeing Air Transport has laid more emphasis on airmail, its new three-engined biplane will be an excellent passenger plane, and there is no doubt that this company will play an important part in passenger service.

Unfortunately, lack of space does not permit us to deal with the many other lines now in operation, and doing splendid work.

The railroads are losing much of their short-haul passenger traffic to the automobile and the motor bus. There is no doubt that more and more first-class mail will go by air. Will the railroads lose passenger traffic in large volume to the airlines? Extremists go so far as to say that eventually there will be more passenger travel by air than by rail. We do not believe that this will be the case. It is only on long distances and under certain geographic conditions that the airplane will be supreme. We believe rather that the railroad executives, profiting by the lessons learned from automobile competition, will do their utmost to co-operate with the plane companies, and may in fact become the leading users of modern transport airplanes.

F. Desmond Sprague, writing in *Railway Age*, a well informed and progressive magazine, points out many ways in which a railroad system can use air transport. It can shorten the distance where geographic conditions make the line circuitous, and provide scenic excursions as a feeder to main lines where a short rail line is likely to prove unprofitable. Furthermore, a railroad acting in co-operation with an air transport company can greatly reduce the operating expenses of the latter in the matter of selling expenses, ticket offices, time-tables, advertising, telegraphic dispatching, et cetera. Heavy baggage also will probably be better handled by checking on regular trains than by straining the carrying capacity of the airplane.

There are indeed some strong arguments for the superiority of the airplane advanced by the airplane enthusiasts. An interesting comparison of several items has been made by N. D. Ballantine in *Airway Age.*

THE distance between New York and Chicago by air is 712 miles; by rail it is 908 to 1013 miles, depending on the route. The schedule by the fastest train is 20 hours. By air it will be less than six hours, and there is no reason why there should not be sleeper airplanes very shortly. Railroad fare, plus meals, comes to about 55 dollars. Granted that 10 cents a mile is a fair figure for the airplane, the saving of time will make air travel actually cheaper for the business man. Further analysis shows that the investment per passenger will be greater for the train than for the airplane, and more men will be required to "protect a run" per passenger.

However, great railway executives such as General W. W. Atterbury, President of the Pennsylvania Railroad, are fully aware of this possibility of competition, and General Atterbury has made a most convincing statement in favor of the probability of continued passenger travel by rail. The automobile, so General Atterbury tells us, was once greatly feared by the railroad. But the extraordinary thing is that as automobile traffic increased, so did railway traffic! He closes the discussion, to our mind, by saying: "Each kind of transportation should be developed in co-operation with the others, with the understanding that each has its own special field in which it particularly excels. The public should have the best form of service that each can produce, or which can be rendered jointly by two or more in combination."

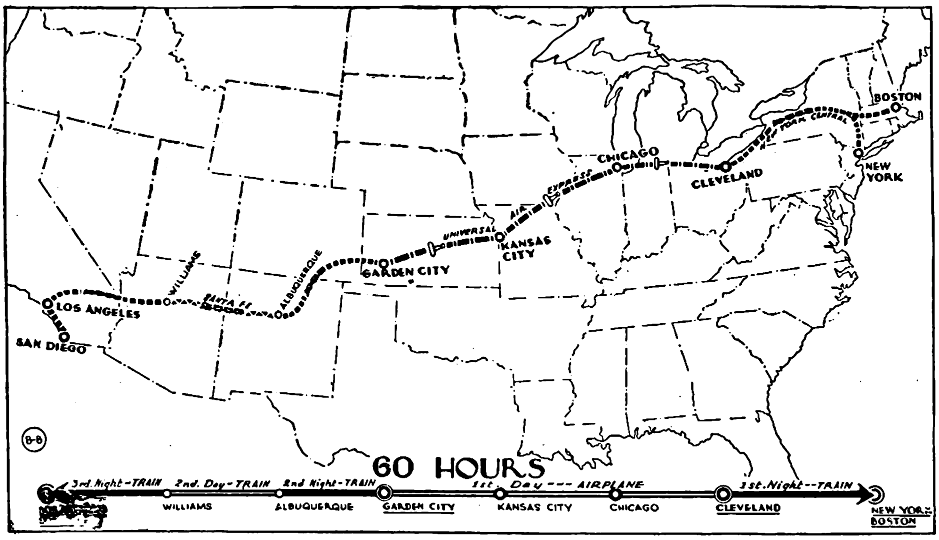
GENERAL ATTERBURY and the Pennsylvania Railway have shown the courage of their convictions by co-operating actively with one of the two transcontinental passenger air-rail services already in existence—the T. A. T. or Transcontinental Air Transport.

This large company, with a capital of 5,000,000 dollars, was formed in the spring of 1928, by a group including the Pennsylvania Railroad, the Atchison, Topeka and Sante Fe Railroad, National Air Transport, and prominent bankers and business men of New York, St. Louis, Louisville (Kentucky), and San Francisco. C. M. Keys, president of the Curtiss Company, was elected president of the new corporation, the directors including men experienced in aviation and transportation generally. The 5,000,000-dollar capital was apportioned as follows: 2,000,000 dollars for operation; 1,000,000 dollars for meteorological and other investigation, and 2,000,000 dollars for a general reserve.

It may seem comparatively easy to establish an airline, easier than to establish a railroad for example, but there is in effect a great deal of preliminary work to do. The T. A. T. were fortunate enough to secure Colonel Charles A. Lindbergh as Chairman of the Technical Committee, with C. S. ("Casey") Jones, the famous commercial pilot with many air race victories to his credit, and Major Thomas Lamphier, an officer with a distinguished record in the Army Air Corps, as his associates.

The executives of the company, aided by this Technical Committee, did a great deal of careful preparatory work.

The first problem was the selection of the route itself. It was decided at the outset that the Alleghany Mountain section, considered dangerous flying territory owing to its rugged character and unsettled weather, should be covered in a night journey by rail. T. A. T. passengers, traveling westward, board their train at 6:05 P.M.



THE TRANSCONTINENTAL ROUTE OF THE GREAT CIRCLE LINE

at the Pennsylvania Station in New York City and arrive at Columbus, Ohio, at 7:55 in the morning. At Columbus the Pennsylvania Railroad is building "Port Columbus" the first air-rail station to be erected in this country.

Here passengers change to the ten- or twelve-passenger tri-motored metal-built Fords. They leave Columbus at 8:15 A.M. and reach Waynoka, Oklahoma, at 6:24 P.M., having flown 912 miles in the single day's journey. There are intermediate stops at Indianapolis, St. Louis, Kansas City, and Wichita. A "Fred Harvey" lunch is served on the plane between St. Louis and Kansas City.

LEAVING Waynoka at 11 P.M., the travelers proceed by train to Clovis, New Mexico, arriving at 8:25 in the morning. From Clovis to Los Angeles there is another plane flight of 897 miles, the great western city being reached at 5:25. In selecting this route, careful investigations of weather conditions, altitudes, and intermediate landing fields were made. The southwestern route was selected in preference to the direct airmail route from Chicago to San Francisco because the flying is in lower altitudes with more settled weather, and over parts of the Rockies which are not very high.

The total time for the journey is 48 hours, as compared with the average five day train journey. At a later date a supplementary all-air service between Columbus and the Pacific Coast will be established. This will involve night flying but will cut the trip by several hours.

The total cost of the trip, including lower berth and extra fare on the train from New York to Port Columbus and exclusive occupancy of a compartment on the Santa Fe is $351.94, something like 50 percent more than by train—an important but not a prohibitive difference.

The T. A. T. transcontinental passenger service was officially inaugurated on July 8th, but the honor of offering America the first service of this kind belongs to the Aviation Corporation, through its subsidiary, the Universal Aviation Corporation, its first passengers beginning their journey on June 12th.

The Universal employs the splendid Fokker tri-motored planes and in conjunction with the New York Central and the Atchinson, Topeka and Santa Fe offers a 60 hour service from coast to coast. The service consists of overnight train travel to Cleveland; a 1087-mile flight from Cleveland to Garden City, Kansas, via Toledo, Chicago, and Kansas City, with longer stops at Chicago and Kansas City for meals, and then a rather lengthy train journey from Garden City to Los Angeles.

The airway is known as the "Great Circle Route" because flight is almost directly on the great circle. The line cuts through the heart of the United States and is fed by air and rail feeder lines from all sections, making it convenient for many large cities in the United States and Canada. The transcontinental fare is surprisingly low on the Universal Service, being only about 235 dollars.

Besides the two transcontinental services, T. A. T. and Universal Aviation, quite a number of other airways work in co-operation with the railroads.

Northwest Airways, Chicago to Green Bay, advertises itself as the "First Co-ordinated Air-Rail Service in the United States," and has its tickets on sale with the Northern Pacific; Great Northern; Chicago, Milwaukee, St. Paul and Pacific; Pennsylvania; B & O; and New York Central.

The Pacific Air Transport makes connections with certain trains on the Pacific Coast.

The Southwest Air Fast Express connects with El Paso by Texas and Pacific Railway.

On the Chicago-Detroit airline of Stout Air Services, passengers can book through to New York.

PAN AMERICAN has operating arrangements with the Atlantic Coast Line Railroad and the Florida East Coast Railway and through rail-air service is maintained from any point in the United States to any point on the airways.

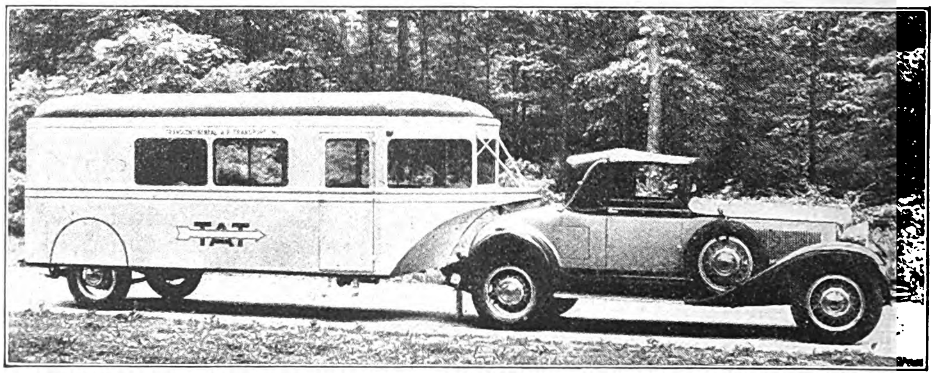
Standard Air Lines connects with the Texas and Pacific's train *The Texan*, which provides transportation to the north and east.

The co-operation between the airlines and the railroads is certain to increase as time goes on.

There is one thing that is remarkable in the organization of T. A. T. and that is the care which has been taken to secure the best possible aids to navigation.

Colonel Lindbergh and an associated group of engineers decided that for the maximum comfort of passengers, hops should not exceed 250 miles. With extraordinary care first class fields were located and developed at Columbus, Indianapolis, St. Louis, Kansas City, Wichita, Las Vegas, Gallup, Winslow, Kingman, and Los Angeles. Intermediate emergency fields were also located by practical flying over the route. In this the T. A. T. showed no great originality.

Where the executives of T. A. T. did show boldness of vision and originality was in recognizing the fundamental importance of weather service and a



THE AERO CAR USED IN THE T.A.T. SERVICE

complete system of communications. Let us quote from a statement by C. M. Keys, the president of the company.

"We laid down as a fundamental that there must be two factors in this operation which are not found in complete form in any other air transport operations in the country, namely, first, an intensive meteorological service along the right of way, and, second, a complete communications system along the ground and a complete communications system between the plane and the ground and between the ground and the plane.

"SO far as meteorology is concerned, we started with the Weather Bureau. The service of the Weather Bureau to airplanes in flight is enormously better than it was a few years ago and gets better day by day. It cannot, however, be expected that a government service can adapt itself specifically to the uses of an air line.

"We cannot expect, and we do not expect, that Uncle Sam will establish across a strip of the United States 100 miles wide and 2000 miles long, a detailed weather service that will work at particular hours of the day for our benefit. We shall need that service working efficiently and accurately at the hours of the day when our passenger planes are flying.

"We have drawn upon the Weather Bureau for personnel, both at the top and down the line of employment. We have drawn upon the records of the Weather Bureau for fifty years past in making due allowances for prevailing winds, for fog, bad air conditions, et cetera, at every point along this right-of-way. I know that you would be interested, if there were space to go into details of this weather service which is so much more necessary to us that it is to you, to whom storms, snow, fog, and rain mean very little, compared with what they mean to us.

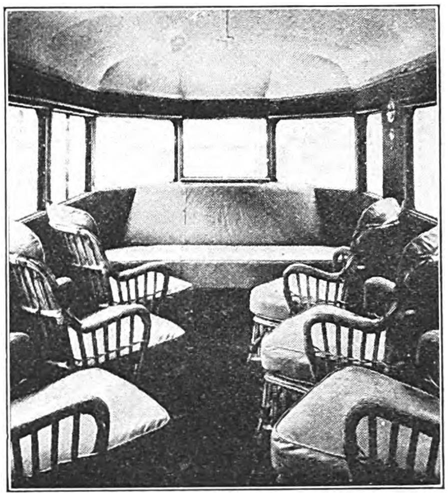
"The communications system also entailed elements new and old. In fact, it entailed elements which did not exist in this country when we started our demand for them. The land communication is, of course, by telephone and telegraph and here again the railways co-operate as far as they properly can, but in the main we rest upon our own resources, drawing upon the American Telegraph and Telephone Company and the telegraph lines for our facilities. This is more or less routine, being merely a draft upon things already well established.

"The radio communication consists of two elements: First, the radio direction installation and, second, radio communication both ways.

"THE directional radio has been worked out in close co-operation between the government and the radio companies, and this installation, which will give to the pilot his general location at all times while in the air, by day and by night, is more or less standardised, being in use on many of the airmail lines of the country.

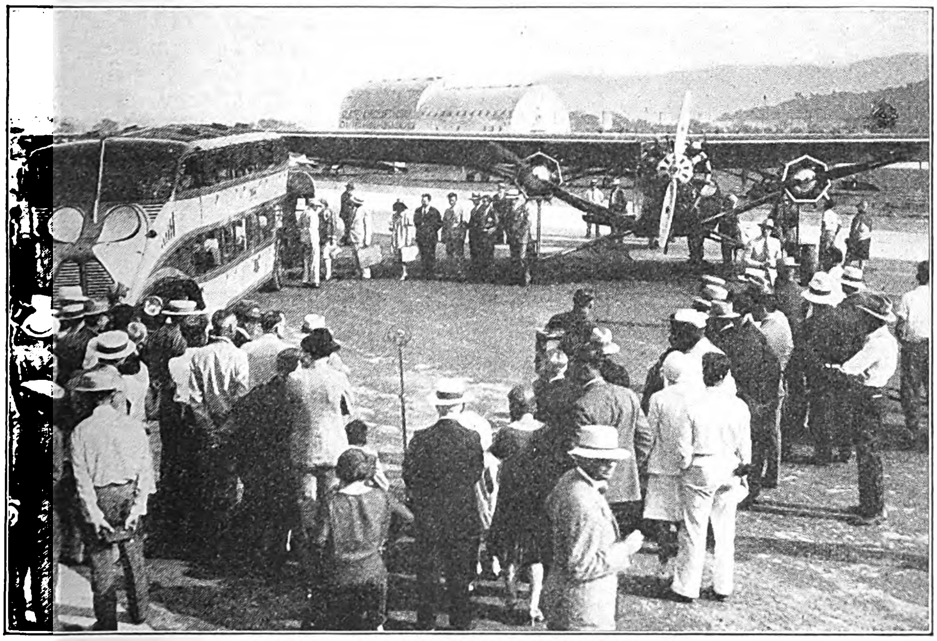
"The actual audible communication between the plane and the ground and the ground and the plane is the number one factor of safety in passenger transport. It is the block signal system of the air. An air transport passenger line without it will be illegal a few years from now.

"All the weather information collected by the meteorological system must be transmitted instantaneously and continuously. That, again, is not so difficult. For a time it looked as though that was all we were going to be able to have, because our first figures on the installation of transmitting equipment in the plane itself indicated that we might have to sacrifice room for two passengers in order to take care of the weight of this system.


AERO CAR INTERIOR

In these comfortable cars, passengers are carried from centers of cities to the airport

"Intensive research has been carried on by the radio companies for the past six months and as a result we are now promised definite installations in the planes at a weight that is more or less negligible, so that our pilots can communicate instantaneously and at all times with the ground stations to ask additional weather information, wind velocities, and so forth."

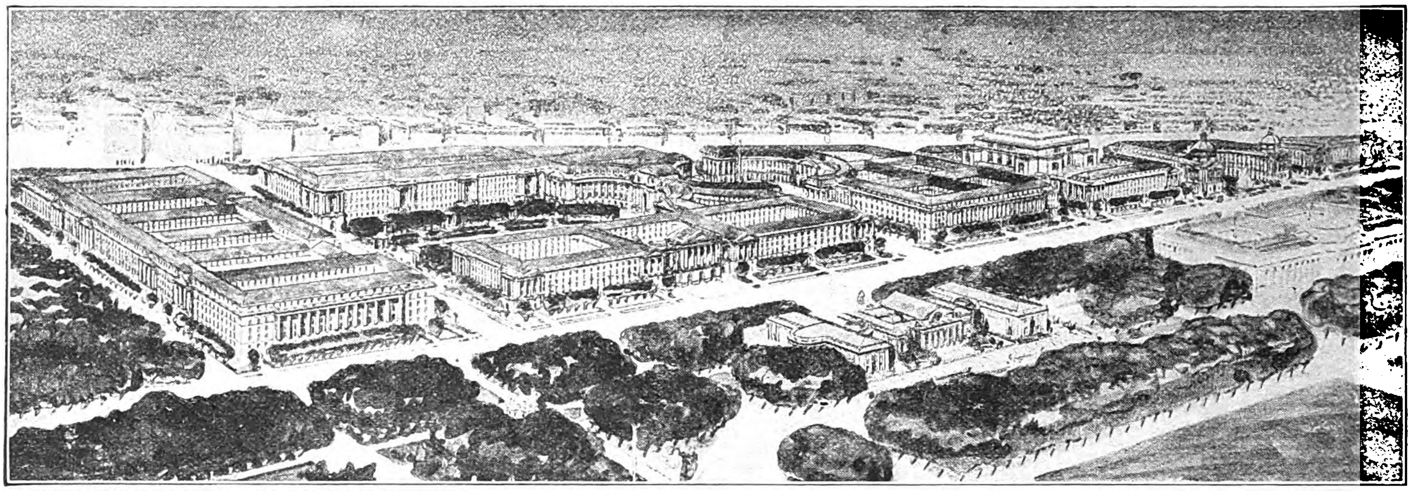

WHERE PLANE MEETS MOTOR BUS

Scene at the Grand Central Air Terminal at Glendale, California. Passengers on Pickwick Airlines are transferring from the three-motored plane in the background to the motor bus

IT is interesting to note also that air and motor bus co-ordination has also begun. Thus in the month of June, the Pickwick Airlines placed in operation night coaches in combination with three-engined airplanes, between San Diego, Los Angeles, San Francisco, and Seattle. The daily trips between San Diego and Seattle will take 23 hours and 10 minutes. Here again we have the principle of night travel on the ground, and flying by day.

A rather curious development of air transport is the Aero car designed for the use of Transcontinental Air Transport, in carrying passengers between the downtown sections and airports in cities on the coast-to-coast air-rail route. The rear section, which has a capacity of 14 passengers, has a telephone connection to the driver's seat in the power unit. The telephone set is designed like a radio microphone with the receiving end connected to a loudspeaker. Repeated tests of the Aero car loaded to full capacity have shown that it does not hinder the functioning of the power unit. The extreme comfort of the new vehicle is

(*Please turn to page* 359)



Courtesy of the Office of the Supervising Architect, Treasury Department

THE PROPOSED DEVELOPMENT OF THE TRIANGLE

This great group of office buildings, to be used by the various commercial branches of the government, will cost about 200,000,000 dollars and require many years for completion. The enormous building at the base of the triangle is the Commerce building, now being constructed

Greater Washington Starts to Rise

Launching the Most Ambitious Construction Program in Its History, Congress Furthers the L'Enfant Plan

By HENRY W. HOUGH

VIEWING the city of Washington from an airplane, one admires the monumental government buildings, the impressive memorials, the wide streets radiating from the Capitol and the White House, and the natural loveliness of the setting. But there is something else about the panorama that impresses the spectator. With striking clarity one is able to visualize the magnificent plan for the city, which will ultimately make Washington the world's most beautiful capital.

Rare vision and exceptional intelligence must have been possessed by George Washington and Pierre Charles L'Enfant, who stood on the green hills overlooking the Potomac River where the city is now situated, and sketched the plans for a capital worthy of a great nation. Gradually the city has grown, and gradually the L'Enfant plan has been translated into broad avenues and open parks, bounded by the great buildings in which is carried on the work of the government. The city seems to scorn modernism, particularly in its architectural features. Tall buildings are taboo, and rapid transit facilities are unnecessary. There is something strangely timeless about the city, as if its builders and the inhabitants are content with the realization that the most enduring beauty is to be found in adhering to styles of classic simplicity. Washington is a city of the south, and is more than content with its heritage.

During the early years of the republic closely following the devastating Revolutionary War, construction was started on the President's House and other important federal buildings. In 1814 the city was partially destroyed by the British, but the President's House was painted white to cover the marks of fire, and the work of building the city went on. Even during the nation's most trying ordeal—the Civil War—the development was continued and the dome of the Capitol was completed. Slowly the great city of today came into being, but all attempt at architectural control had been abandoned. Like Topsy, it "just growed."

Each generation has inherited as a sacred trust the responsibility of doing its best to carry toward completion the beautification of the city, and to provide improvements and additional buildings when needed. About two years ago the Treasury Department pointed out that the government needs new buildings urgently, and that the delay in constructing them is exceedingly expensive because the government is now paying high rentals for floor space. The way to a Congressman's heart is through the pocketbooks of his constituents, and without further delay an appropriation of 75 million dollars was authorized for buying land and starting construction on a group of buildings of which the total cost will be about 200 million dollars.

ECONOMIC necessity had provided the incentive for the appropriation but other incentives motivate those who have been entrusted with the task of designing and constructing the buildings. In a recent address, President Herbert Hoover said, "The government is expending vast sums for rented buildings throughout the city, and this expense will be eliminated.... Congress has authorized the beginning of a great program which must extend over many years. It is our primary duty to do more than erect offices. We must fit that program into the traditions and the symbolism of the capital. Our forefathers had a great vision of the capital for America, unique from its birth in its inspired conception, flexibility, and wonderful beauty. No one in 150 years has been able to improve upon it. It is the wish and demand of the American people that our new buildings shall comport with the dignity of the capital of America, that they shall meet modern requirements of utility, that they shall fulfill the standards of good taste, and that they shall be a lasting inspiration."

It was decided to group the new commercial buildings in the heart of the city, in a triangular tract with an area of about 74 acres or 23 city blocks. Just such a development had been contemplated by L'Enfant in his remarkable plan for the future capital. The points of the Triangle are, roughly, the Washington monument, the White House grounds, and the Capitol building. The Triangle is bounded by two broad parks and "the Avenue," famous as the scene of the great inaugural processions. When it was decided to utilize this incomparable location for the new commercial buildings, the simple demand for floor space was transfigured into the great Triangle Plan, which is the greatest ever conceived for a single group of governmental buildings.

At the base of the Triangle there is now an eight-acre crater, in which are 13,500 cast-in-place concrete piles averaging about 25 feet in length. This is to become the monumental new Department of Commerce building, which will cost approximately 17,500,000 dollars and be considerably larger than either the Capitol or the House of Parliament. It will be 1650 feet long, 325 feet wide, seven stories in height, and will have 48 acres of floor space. The new building will house all of the branches with the exception of the Bureau of Standards, located on the outskirts of the city.

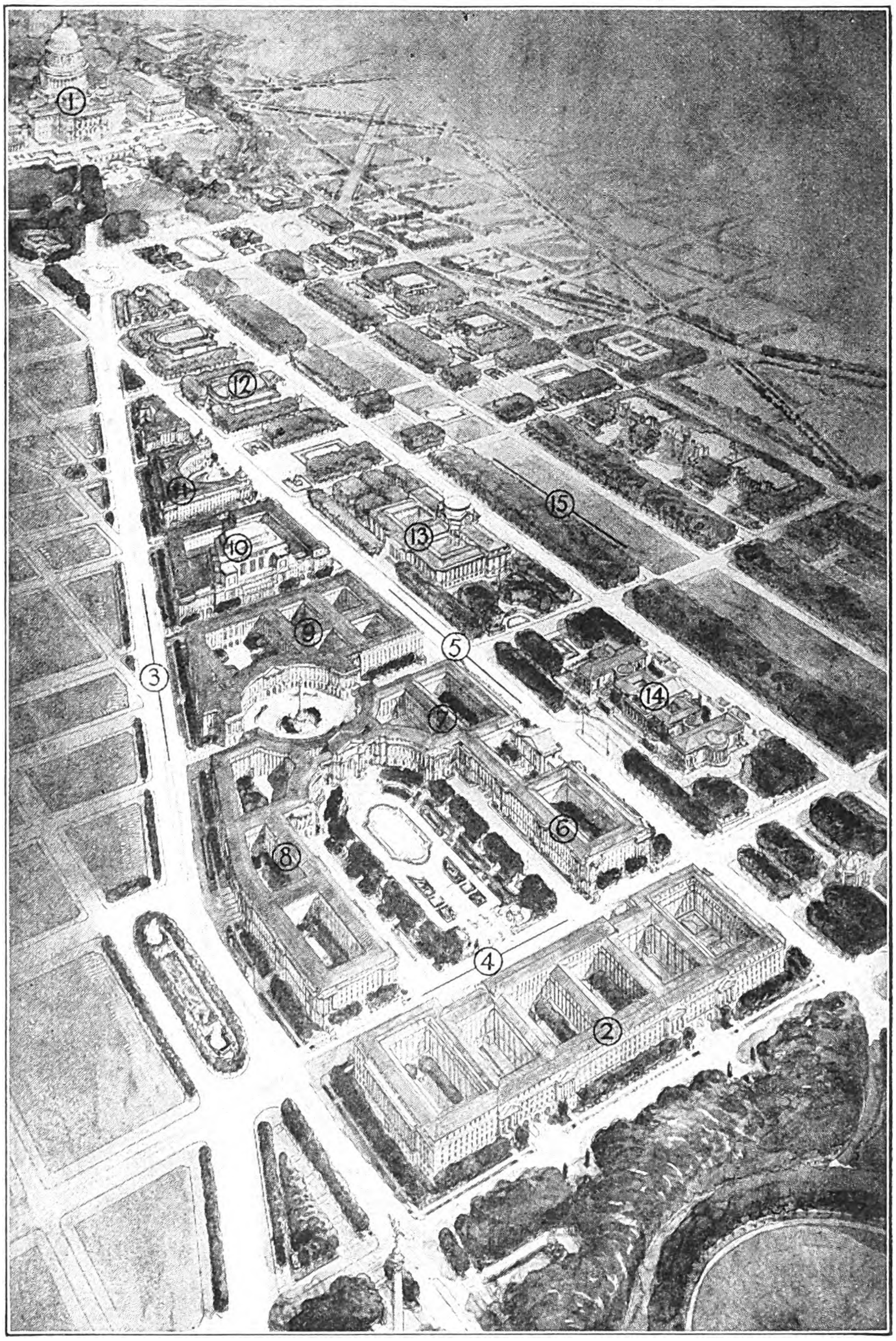
The Patent Office will occupy the entire north rectangle, with all public serving units on the ground floor, including the spacious public search room, record room and library, cashier and units for applications, assignments, manuscripts, and photostats. The examining corps will occupy the four upper floors, with semi-private space for each examiner and every consideration for such factors as convenience, supervision, light, privacy, quietness, and future expansion.

THE south rectangle of the Commerce building has been assigned to the Coast and Geodetic Survey and the Census Bureau. The middle group, which is somewhat larger than the others, will be occupied by the executive and administrative offices of the Department, a large library, conference rooms, a cafeteria for the building's 5000 employees, and the more compact bureaus and services including the Aeronautics Branch, Radio Division, and the Bureaus of Foreign and Domestic Commerce, Mines, Lighthouses, Fisheries, Navigation, and Steamboat Inspection. The building faces the Great Plaza, which will be enclosed by the other buildings of the Triangle. The exterior is characterized by great simplicity, almost devoid of ornamentation except for the porticos and gateways which give access to the various units of the building.

Another huge building now under construction in the Triangle is to house the Bureau of Internal Revenue. This structure will cost about 10,000,000 dollars, and is to be completed within the next two years. The sum of 8,750,000 has been authorized for the construction of an Archives Building, to provide a safe place for keeping valuable government records. Other buildings to be built within this area include a group for the Department of Labor, Interstate Commerce Commission, Tariff Commission and other independent establishments, and the Department of Justice. Two open areas are included within the Triangle, one a rectangle 764 feet by 597 feet which will be known as the Great Plaza, and a circle 375 feet in diameter to be known as the Circular Plaza.

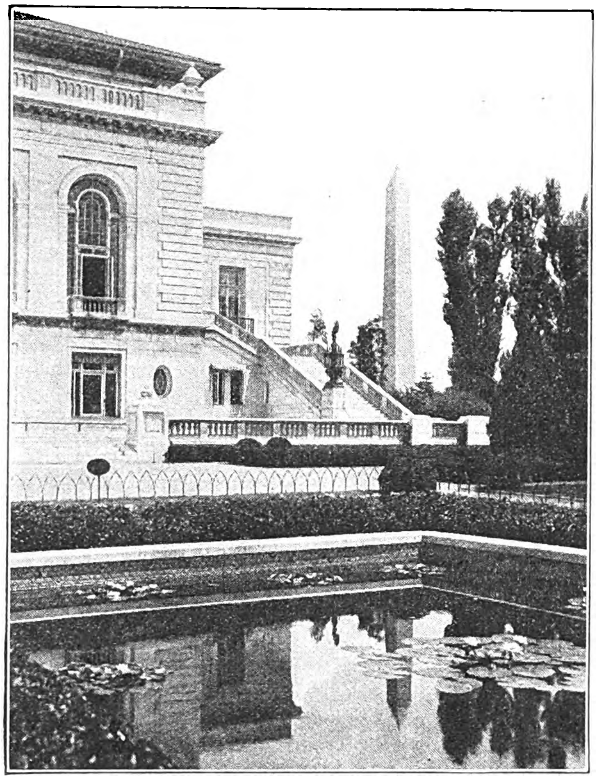
This development will redeem Pennsylvania Avenue, now marred by many unsightly buildings, and will provide a northern boundary for the Mall, the wide park leading from the Capitol to the river. It will also expedite the conversion of B Street, paralleling the Mall, into a great ceremonial thoroughfare extending from the Capitol grounds to the new Arlington Memorial Bridge, near the Lincoln Memorial. Although such an undertaking cannot be completed for many years, the grandeur of the development can be appreciated by studying the truly remarkable set of plaster models made by Bertram Keyes now on exhibition in the Treasury Building. (See page 110, August, 1929 SCIENTIFIC AMERICAN.)

On the other side of the Mall from the new group, workmen are busily engaged in completing the Department of Agriculture building, and the same department is soon to have another building for housing some of its numerous bureaus. An extension to cost 1,250,000 dollars is to be added to the United States Government Printing Office, located north of the Capitol near the Union Station. Nearer the



ARRANGEMENT OF THE NEW BUILDINGS IN THE TRIANGLE

The proposed Triangle development: 1, the Capitol; 2, Commerce Building; 3, Pennsylvania Avenue; 4, 15th Street; 5, B Street; 6, Department of Labor; 7, Interstate Commerce Commission; 8, Independent Establishments; 9, Bureau of Internal Revenue; 10, Archives building; 11, Department of Justice; 12, Washington Memorial; 13, National Museum; 14, National Art Gallery; 15, The Mall, the park leading from the Capitol to the river



WASHINGTON MONUMENT ENFRAMED

The stately obelisk which dominates Washington, reflected in a quiet pool in the beautiful gardens surrounding the building of the Pan-American Union

Capitol, the office building of the House of Representatives is to have an extension which will cost about 7,500,000 dollars, and its companion structure, the Senate office building, is to receive a 2,000,000 dollar addition. A new building for the Supreme Court is to be built facing the plaza east of the Capitol, at a cost of about 9,740,000 dollars, unless present plans fail to materialize. Congress has appropriated 4,912,414 dollars for completing the park between the Capitol and the Union Station, and for carrying out the long delayed plans for the redemption and development of the Mall.

THE beautiful Arlington Memorial bridge over the Potomac at the western end of the Mall is now under construction; when it is finished it will represent an expenditure of about 14,750,000 dollars, including the cost of approaches and a formal terraced avenue leading to Arlington Cemetery on the Virginia side of the river.

A total of 116 million dollars has been authorized for federal buildings and other new developments in the city. The expenditures for this year will not exceed 11 million dollars, and for next year not more than 24 million dollars, according to Senator Smoot of Utah, Chairman of the Public Buildings Commission.

One of the factors contributing to the beauty and importance of the city of Washington is the presence of many unofficial organizations, several of which occupy buildings of rare beauty. An outstanding example is the group on 17th Street, facing the Monument grounds, including the Corcoran Gallery of Art, the Red Cross building, the Continental Memorial Hall of the Daughters of the American Revolution, and the building of the Pan-American Union. It seems that the new Washington would be incomplete without the beautiful Pan-American building, which typifies the cultural relations with our neighboring countries in much the same way that the mammoth new Commerce building will serve as a symbol of our great commercial enterprises at home and abroad. Extensive gardens of unusual charm encircle the marble building, and inside is a beautiful patio 60 feet square, with a sculptured fountain and a great profusion of luxurious tropical shrubs and flowers.

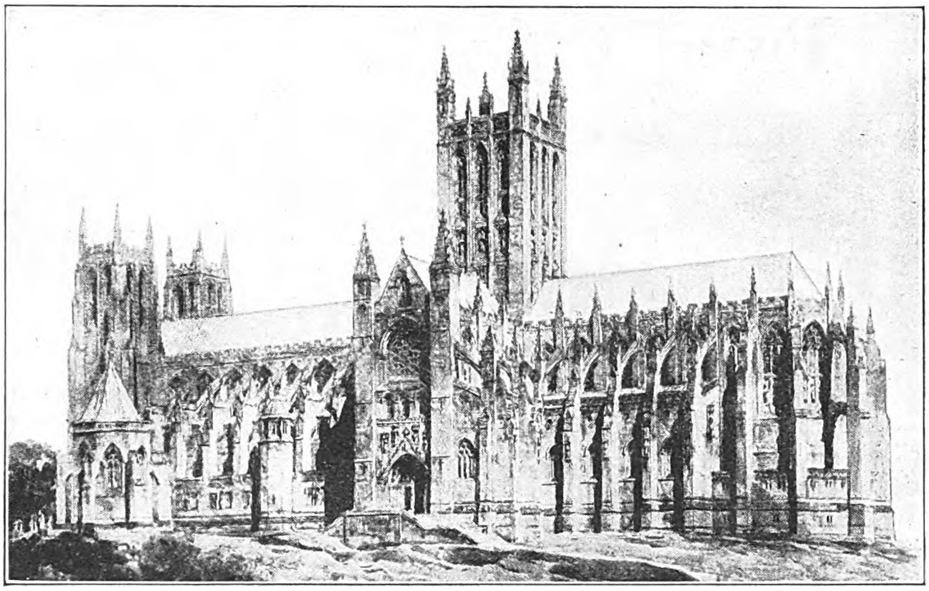
On the slopes of Mount St. Alban, overlooking the city, is being built the great Gothic cathedral visualized by Washington, L'Enfant, and other founders of the country as a house of prayer for all people. Every year hundreds of thousands of visitors and worshippers pause to view the tombs of Woodrow Wilson, Admiral Dewey, and others buried here. From the natural amphitheatre, where open-air services are held when the weather is favorable, a commanding view of the entire region can be obtained.

The Washington Cathedral, which will be an outstanding example of 14th Century English Gothic architecture, was chartered by Congress in 1893. The edifice is being built by the Protestant Episcopal Cathedral Foundation on a 67-acre tract including the highest elevation in the District of Columbia. More than 6,000,000 dollars has been contributed to the National Committee for Washington Cathedral, of which Andrew Mellon is treasurer. General Pershing, who led the American army during the World War, is chairman of the Committee. He recently declared that his two greatest interests are, "building monuments in France to the memory of the service of American soldiers in the World War, and assisting to build this great cathedral to the glory of Him to Whom we owe all of our greatness." It is being built, as rapidly as funds are provided, in the shape of a cross. Two square towers flank the main entrance, and a great central tower surmounts the crossing of the nave and the trancepts; the main tower will rise 107 feet higher than the Washington monument.

WITH the attention of the world focused on aeronautical developments, it is not strange that Washington should feel the need of adequate airport facilities, which are sadly lacking at present. Looking ahead, it seems inconceivable that the capital of the United States should be without adequate provisions for flying fields, but no satisfactory developments have yet been approved, due to the perennial controversy between the Federal government and the District of Columbia. A great airport worthy of the capital could be built at Gravelly Point on the Potomac river between Washington and Alexandria, which is close to the

SPANISH AMERICA IN THE HEART OF WASHINGTON

Within the spacious halls of the Pan-American Union building, Latin America holds sway. The open patio has a sculptured fountain, surrounded by luxurious tropical vegetation city and has been approved by the government's aviation authorities. A recent proposal presented to Congress was defeated, because certain provincial-minded legislators wanted to make the over-burdened tax-payers of the District of Columbia pay 90 percent of the cost of the National Airport, without providing any assurance that the site to be developed would be under the supervision of the District. Certain interests would like to see the airport located somewhere in Maryland, and others would support almost any site located in Virginia. As a result, Washington is in a position no modern city would envy.



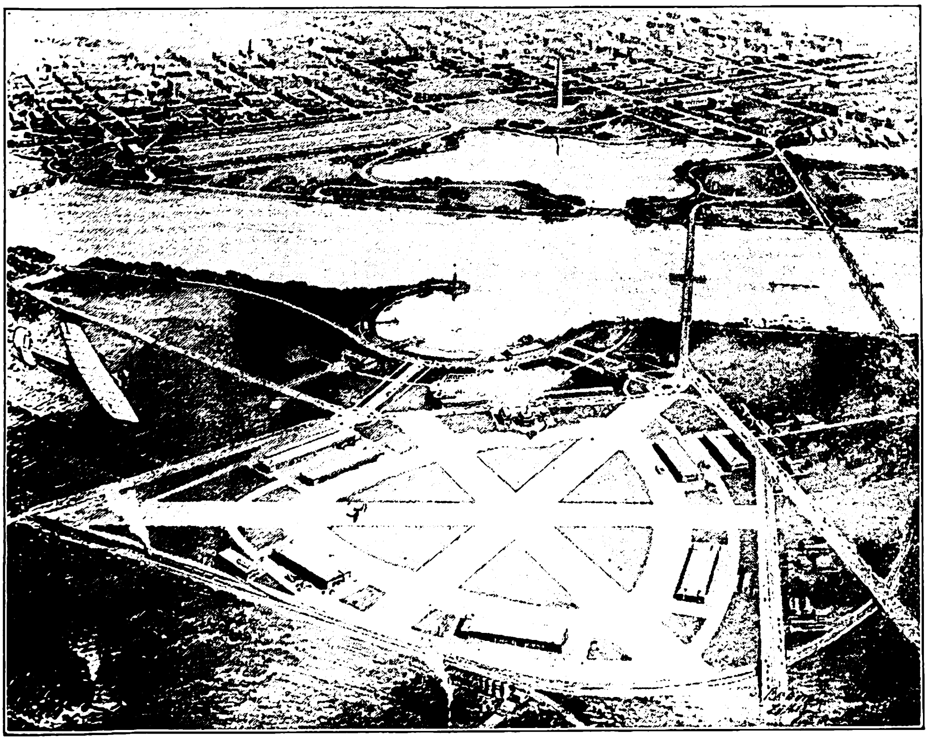
WASHINGTON CATHEDRAL AS IT WILL BE WHEN COMPLETED

Situated on Mount St. Alban, overlooking the city of Washington, this great Gothic cathedral will take its place as an integral part of the plan prepared by Pierre Charles L'Enfant

WASHINGTON Airport, one of the commercial fields just across the river from the city, is being developed into a well-equipped port to accommodate passengers or mail. About 180,000 dollars is to be expended within the next two years for hangars, enlarging the landing field, and clearing the obstructions nearby, according to the officials of the company. The same concern operates the New York-Washington Airline, Inc., which provides regular one and a half hour flying service between the two cities. A larger landing field is being prepared at a site several miles south for handling transport business.

Under the present schedule, it seems that the development of the capital is being carried forward adequately, as far as the public buildings are concerned. However, other considerations need attention, according to the American Institute of Architects, a group which deserves the nation's thanks for stimulating interest in the present program to beautify Washington. The most urgent need, according to the architects, is the improvement and development of the park system. The present million-dollars-a-year is considered but a drop in the bucket, because the desired land is being either wiped out by development (with elimination of irreplaceable tree growth), or its value is appreciating so rapidly that it cannot be purchased.

At the present rate of purchase, even if the land were not made useless for park purposes, it would take 40 years and a corresponding number of millions to acquire it. The Institute points out that some broad-gage legislation is urgently needed, as a matter of economy if for no other reason. A bill introduced into Congress by Representative Cramton of Michigan would provide for the situation; it has been passed by the House of Representatives, but at this writing is awaiting consideration by the Senate. Better provisions for transportation, and development of the water front, are also improvements that should be made without undue delay. These matters, like the proposed National Airport, await the pleasure of Congress.



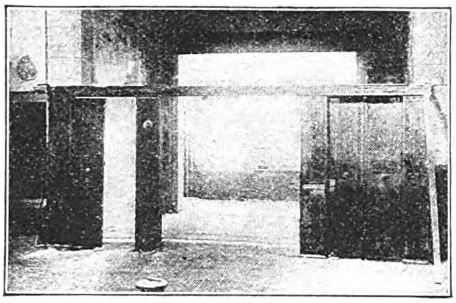
PROPOSED DEVELOPMENT OF WASHINGTON AIRPORT

Artist's conception of the Washington Airport when completed. This airport is now relatively small, but provides a close-in terminal for local and inter-city passenger service

WASHINGTON, like the beautiful capital cities more recently designed at Delhi and Canberra, is an enduring symbol of the importance of architectural control. The first President inaugurated a code of restrictions well designed to prevent the erection of any structures which would impair the beauty and harmony of the city. In 1818 President Monroe was persuaded to suspend these regulations. Deviations from the L'Enfant plan added to the resulting confusion.

For many decades the Mall was disfigured by the tracks and station of the Pennsylvania Railroad. The company finally decided to build a viaduct over the Mall, and the resulting controversy led to a revival of interest in the original plan for the city. The McMillan Commission, appointed by Congress in 1901, submitted a far-reaching plan to carry forward the development of the greater Washington. Within the past 30 years the present program has been approved and construction started. Within another 50 years, if favored with concontinued peace and prosperity, the nation should see the magnificent vision of L'Enfant fulfilled.

From the Archeologists' Note Book



A ROMAN WOODEN PARTITION

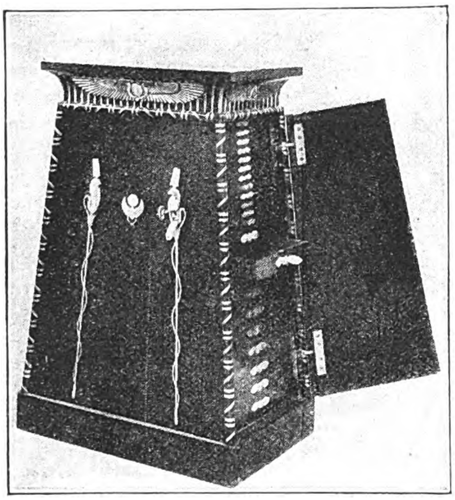
From a house in Herculaneum just uncovered. Wood preservation is very rare

UNCOVERING HERCULANEUM

A large number of the houses have now been uncovered, disclosing many interesting finds, as the wooden partition at the left. Everything wooden at Pompeii was destroyed by ashes

New Discoveries at Herculaneum

IN our April 1928 issue we published an interesting series of pictures on Herculaneum, which is now being explored by the archeological authorities of the Italian government. We are now able to present later pictures of the excavations. Herculaneum was destroyed by water and mud so that wooden objects were preserved. The King of Italy recently visited the excavations, which are being carried on in a most scientific manner.



ARCHEOLOGY INFLUENCES FURNITURE

A coin cabinet and pedestal with motives for decoration from Egyptian archeology

Egyptian Motives for Furniture

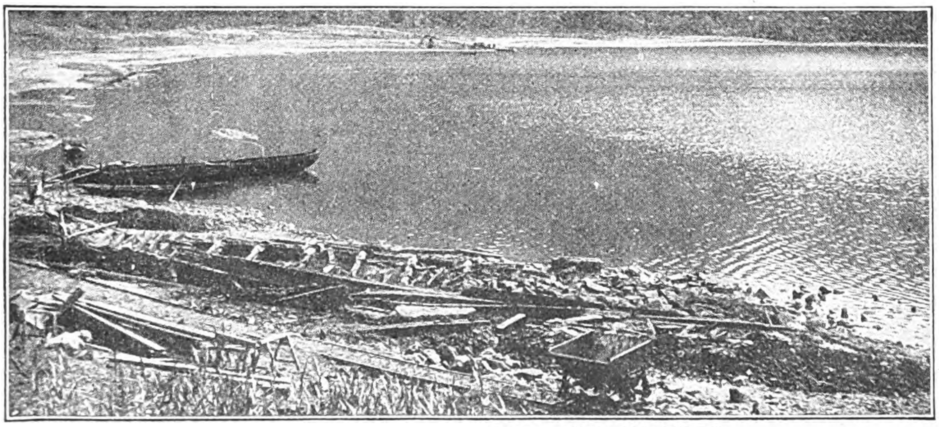
THE influence of archeology is felt in many branches of the arts, and we present a curious piece of furniture, the motives for the decoration being directly inspired by Napoleon's Egyptian expedition. The mahogany coin-cabinet is in the form of an Egyptian pylon with silver inlay and mountings. The ends of the cabinet contain a series of shallow drawers. It is probable that the cabinet was designed for the Emperor himself by the Baron Devon who was taken to Egypt by Napoleon, who afterwards made him director-general of museums. This interesting piece is in the Metropolitan Museum of Art in the City of New York.

DOSSENA AT WORK

Dossena working on a modern "old master." Great experts have been deceived by his very ingenious productions

Uncovering Nemi's Barges

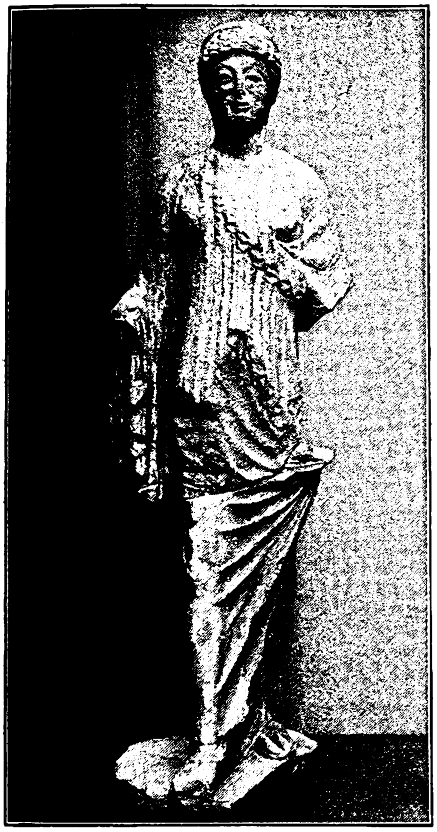
IN our July 1929 issue we gave an account of the interesting work being carried on in draining Lake Nemi in the Alban Mountains near Rome. The Italian archeologists are now coming near the goal, for the first galley or barge has emerged from its watery grave. The remains so far discovered are without artistic treasures such as were secured by diving years ago. The barge, as it should be called, was very wide and very shallow. Only a few feet separate the keel from the deck planking. It is probable that the deck supported a number of superstructures so that it was really little more than a pontoon. Supported by the bulkheads was the planking of the deck, which was very largely torn away by the archeologists of the last century. The hull was covered externally with a substance like felt and then with leaden sheets held in position by long copper nails. The nails, perfectly preserved, are bright and shiny as new. Even if the results prove disappointing, considering the expense involved, Italy is to be commended for this great archeological adventure.



THE BARGE ARISES FROM THE WATERS

The unwatering of Lake Nemi is proceeding apace and here is the first barge to emerge from the depths of the beautiful Italian lake. It is a great, expensive, and well worth while venture

The Detection of Fake Antiquities



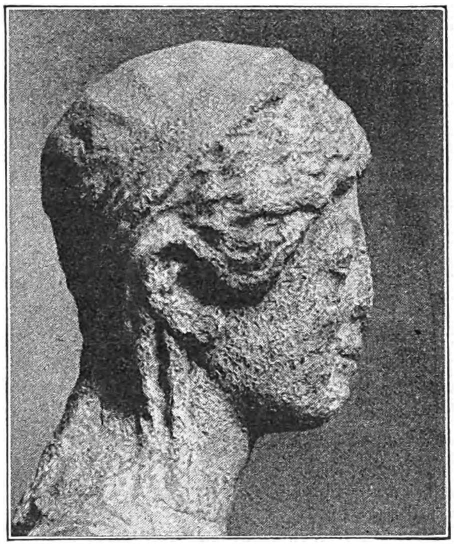
A DOSSENA MASTERPIECE

An original marble statuette in the early Roman style. The modern expression reveals that it is not an antique

THE forgery of works of art always commands great attention in the public press. The Metropolitan Museum of Art has done a good work in establishing a small gallery in which are objects which illustrate the technical side of classical art, and also forgeries, which are intimately connected.

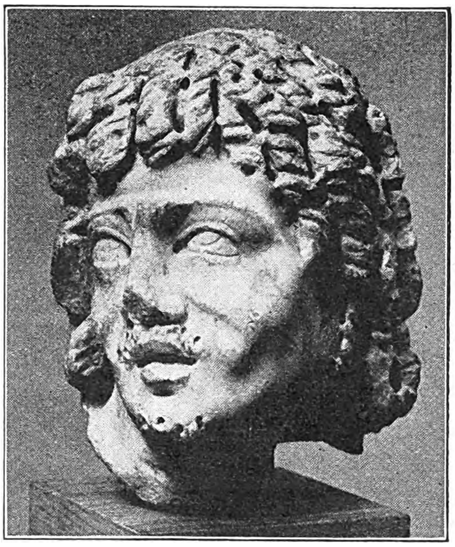
The forgeries exhibited in this room have come to the Museum in various ways. Most of the terracotta statuettes, for example, were purchased about 30 years ago when these often attractive imitations were widely bought. A number of others were occasionally purchased or received by gift as recognized forgeries for study purposes. A few were acquired as bona-fide antiques within comparatively recent times and withdrawn from exhibition in due course when further knowledge made the authorities realize that they must be modern.

The little maiden from Dossena which figured so largely in newspaper accounts, is a good illustration of an up-to-date forgery. It is not directly copied from any one known work of art but reproduces the general style of many in a not unsuccessful fashion, for it might well pass for a nondescript archaistic product (that is, a Roman imitation of the Greek archaic), since its strangely elongated proportions are characteristic of such works. Only the face with its alert, modern expression gives it away. Moreover, the "weathering" uniformly covers the whole surface, not varying according to exposure: it was evidently obtained by "cooking" the marble and then pitting it with a ragged stone. Its dead, brittle character has been reproduced in a few marble fragments to which a great heat was applied. A forgery becomes especially difficult to detect when ancient work is mechanically produced by the pointing process.



A "MODERN" ANTIQUE

Head of the marble statuette to the left. The "weathering" was evidently obtained by "cooking" the modern marble



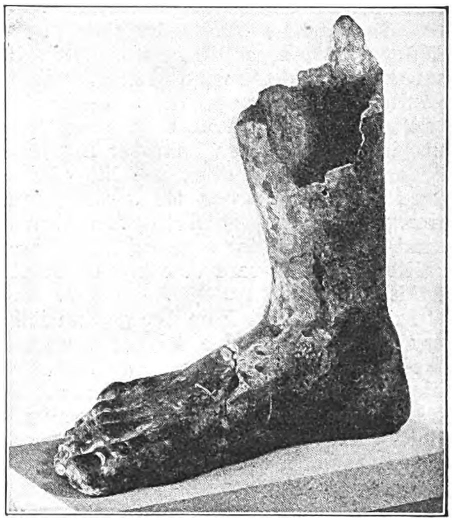
DRILL MARKS IN THE HAIR

Several of the exhibits indicate by their well preserved tool-marks what implements were used by the antique sculptor

All photographs courtesy Metropolitan Museum of Art

CLASSICAL STUDY ROOM

Here is to be found material for study for the detection of modern forgeries



BEFORE ELECTRO-WELDING

The bronze casting was defective so two rectangular patches were welded on

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

The Autogiro

THE following comments on the article "How the Autogiro Flies," starting on page 290 of this issue were put forth by Harold F. Pitcairn in a letter to the author of the article:

". . . there are no conditions that I know of under which the rotor could stop on a properly designed autogiro. Senor de la Cierva found that the rotational speed of the rotor would increase as the forward speed increased on autogiros which had no fixed wings but only ailerons for lateral control. The autogiros we are building are designed so that the angle between the fixed wings and the disk described by the rotor can be altered on the ground. Therefore, if it is found necessary, it will be practical to adjust these machines so that when placed in a dive the fixed wings will exercise a negative lift, thereby increasing the wind-mill action of the rotor which will assure a sufficient number of revolutions per minute under all conditions.

"The fixed wings on the machine in which you flew were mounted at too great an angle of incidence, so that the proportion of total lift that these wings carry increases with the forward speed. Because of this, rotational speed decreases with forward speed. This will not be the case in future autogiros.

"Your article gives the impression that great care must be taken while taxying to prevent excessive strain on the cables which control the position of the blades while their rotational speed is slow. There is never excessive stress on these cables. However, caution must be exercised in taxying rapidly into the wind with the machine in which you flew to prevent the rotor blades from being carried too high before sufficient rotational speed is acquired to give the necessary centrifugal force to hold the blades in place. With the self starting device which will be employed, there will be no occasion to taxi rapidly into the wind before the rotor is turning fast enough.

"Your article states that when the autogiro hits a severe bump or is pulled suddenly out of a dive, the lift of the wings becomes greater than centrifugal force. However, experience has always found centrifugal force to be more than sufficient to take care of every condition of this nature.

"I recognize that from the ground it is very difficult to judge the comparative take-off of an autogiro with an airplane, unless the two machines leave the ground at the same time. I regret that you received the impression it was only equivalent to that of a good OX biplane. From comparative tests we have found that with the autogiro and Mailwing having the same gross load, after the rotor has reached 90 revolutions, the take-off distance is appreciably in favor of the autogiro. Also in carefully measured tests, we found that the angle of climb of an autigiro is considerably better than that of a Mailwing. The rate of climb is not as good but it is the angle of climb and not the rate of climb that helps one out of a small field.

"Also, I would call your attention to the fact that the autogiro up to this time is the development of one man only and that it is reasonable to expect a great deal of improvement in the near future. In fact, Senor de la Cierva has recently been able to double his rate of climb with everything else being equal, by simply changing the plan form of the rotor blades and covering them with plywood.

"I do not think that your statement that the autogiro is inefficient at low speeds is born out of the facts. I believe that it can be demonstrated that its slow speed efficiency is greater than that of an airplane.

"You evidently have the impression that the forward gliding of the autogiro is much worse than is actually the case. While demonstrating the machine it was my purpose to show a steep angle of descent. As a matter of fact, the maximum forward gliding angle of the machine I have been flying I would say is half way between that of a Jenny and a Mailwing. Certainly, the forward gliding angle of an efficient autogiro will be considerably better than that of an inefficient airplane."

Learning to Fly

OUR flying schools are rapidly improving, now that the requirements of the Department of Commerce for the licensing of pilots have been made more rigorous. Even the private pilot, who can get his license after ten hours flying instruction, has to pass an examination in aeronautical subjects. Industrial pilots and transport pilots not only have to have 50 and 200 hours of actual flying respectively, but they must be far better grounded in such subjects, as Theory of Flight, Engines, Rules of the Air, Rigging and Maintenance, Navigation, et cetera, than heretofore.

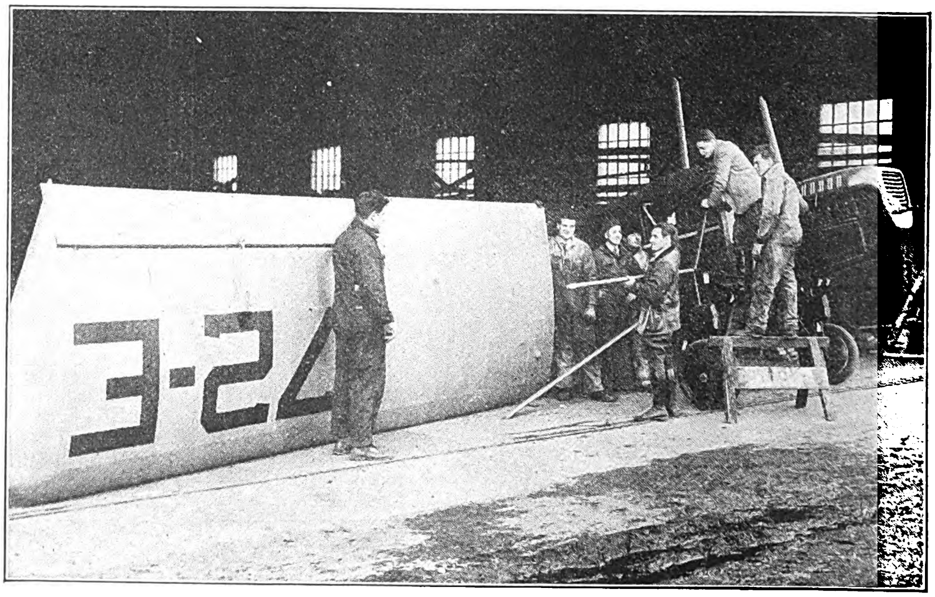
Lowering Parcels from the Air

FOREIGN Aeronautical News of the Department of Commerce reports an interesting invention by a Swiss engineer. The apparatus, called the "Meteor," is designed to permit the delivery of small packages of mail from a plane in flight. It consists of an aluminum shell equipped with a precision watch. A waterproof sack is attached under the shell, and at the top of the shell a small parachute lies folded in a frame. The weight of the apparatus is about eight pounds, and it can carry a weight of nine pounds. When flying over the point at which the mail is to be dropped, the pilot adjusts the precision watch according to the reading of the altimeter, and throws the carrier overboard. The carrier falls like a dead weight until it is some three hundred feet from the ground. The watch then releases the parachute and the package lands slowly on the spot at which it was aimed. A larger model will permit the delivery of a weight as great as 66 pounds.

A New Altimeter

WRITING in *Airway Age*, Guy K. Calhoun describes the very interesting Paulin altimeter, which is being increasingly used for aircraft purposes.

An altimeter is not dissimilar in principle to the barometer, except that the barometer indicates atmospheric pressure and the altimeter, while measuring pressure, is made to indicate the height in feet, corre-



A scene in a Curtiss Flying Service school. See "Learning to Fly" above sponding to the lower pressures found at high altitudes. Sometimes the altimeter is termed an aneroid barometer.

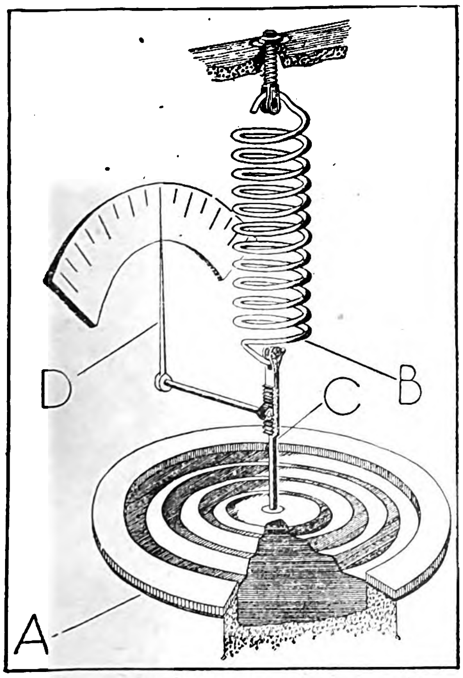
One of our diagrams illustrates the principle of the conventional altimeter. *A* is a vacuum chamber with a flexible diaphragm. To the flexible diaphragm is attached the stem, *C*. One end of the spring, *B*, is attached to the stem and the other is fixed to the frame of the instrument. As the plane rises, and the atmospheric pressure falls, the force exercised on the diaphragm of the vacuum chamber diminishes, and the tension of the spring pulls up the stem, *C*. The motion of the stem is communicated through the rack and the pinion to the pointer, *D*. With suitable arrangements for setting and calibration, the movement of the pointer, *D*, can be made to indicate the height above sea-level.

Of course no altimeter indicates the exact height above sea-level. An altimeter is calibrated for a conventional atmosphere, which represents average conditions. But atmospheric pressures and temperatures are always changing, and without complicated calculations the altimeter gives only the approximate height.

When flying high above the ground, such errors are of comparatively minor importance to the aviator, but when landing in a fog, he must know the height to within a few feet. Hence the research work now being carried on to develop altimeters based on radio, electrostatic, and acoustic principles.

The conventional altimeter also has possibilities of error that are not chargeable to atmospheric variations. There is needed a considerable movement of the diaphragm to produce full scale movement of the pointer. This introduces the "elastic errors of hysteresis." For example, when a plane is descending rapidly, there is a lag in the movement of the diaphragm, and the pointer indicates unduly high elevations. There are other mechanical difficulties.

In the Paulin system, hysteresis and mechanical difficulties are considerably reduced by an ingenious and novel principle illustrated by another of our diagrams. *A* is the vacuum chamber as before connected to the stem *B*, but this stem, instead of acting directly on the spring, is connected to one end of a beam, with the spring, *C*, connected to the other end. One end of the spring, *C*, is attached to a micrometer screw, *D*, and the nut which travels on this screw carries a graduated dial, *E*. The tension of the spring is controlled by the setting knob, *H*, which, when turned, rotates the dial and the nut and thus changes the elongation of the spring, and its tension. When the force of the spring, *C*, is such as to balance exactly the force due to the atmospheric pressure acting on the diaphragm, and the position of the beam is midway between the stops, *G*, balance is indicated by the balance indicator, *F*.



The principle of the ordinary altimeter, in which the diaphragm actuates the indicator, D, directly

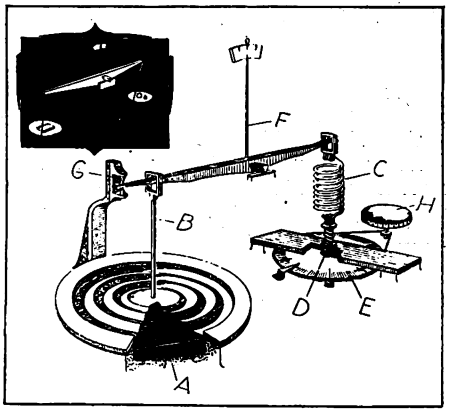
The Paulin altimeter thus weighs atmospheric pressure like a chemist's balance and is very accurate. Because the movement of the diaphragm is limited by the stops, *G*, to a very small amount, there is only little stress in the diaphragm and the "elastic errors of hysteresis" are largely eliminated. It should be noted that the small movement of the diaphragm is multiplied many times on the dial.

The Paulin altimeter

Space will not permit us to describe the instrument in detail. The photograph shows the latest form of the altimeter, with a rectangular face. By using the setting knob and the dial, the pilot can get the pointer to read zero at any desired pressure or altitude. Thus the Paulin altimeter can also be used as a level flight indicator, which is particularly useful in testing for speed, or in making landings in foggy weather.

The World's Largest Seaplane

IN MANY respects Claude Dornier is the most remarkable airplane designer in Europe. Beginning as a naval architect, he continued his career as an airship designer with the Zeppelin Company at Friedrichshafen. There he learned the use of dural as a structural materal for aircraft, and when the Zeppelin Company turned its attention to airplanes, Dornier had no difficulty in adapting himself to this new field. When the Versailles Treaty curtailed German activities in the construction of aircraft, Dornier established his own factory in Switzerland, returning to Friedrichshafen on Lake Constance when the treaty restrictions had become void.



The principle of the Paulin altimeter. Movement of diaphragm is reduced, eliminating errors

Dornier has steadily built flying boat after flying boat, with all-metal construction, side extensions on the boat hull instead of wing-tip floats for lateral stabilization, wing bracing reduced to a minimum, and engines placed above the wing. Passing from one engine to two and then four, he has gradually increased the size of his aircraft, learning the lessons of large flying boat construction as he went along. Now his Do. X, a 12-engined flying boat, has made its trial flight on Lake Constance and is undoubtedly the largest heavier-than-air craft ever flown. For photographs of this huge plane, refer to pages 318 and 319 of this issue.

The Do. X has an overall length of 149 feet. The span of the main wing is 150 feet and the chord of the wing is about 32.8 feet. The aspect ratio of the wing, therefore, is a trifle under five. In building very large wings, a difficulty arises in keeping the bending moments and the weight of the wing withing reasonable limits, and a low aspect ratio with a comparatively short span is a means to this end. Moreover, the low aspect ratio does not affect the high speed very much, but only the cruising efficiency and climb. Probably Dornier has found a slight decrease in aerodynamic efficiency more than compensated for by the decrease in structural weight.

The area of the main wing is approximately 6150 square feet, and the large flying boat is heavily loaded per square foot, since the gross weight fully loaded is 106,000 pounds, or 53 tons. The weight empty is 55,000 pounds, so that there is an ample margin for pay load, and crew, fuel, and oil.

The power plant consists of 12 Bristol Jupiter engines of 625 horsepower each, or a total of 6300 horsepower. The loading is therefore about 16.8 pounds per horsepower, which is also high.

The top speed is estimated at 135 miles per hour. The landing speed is probably quite high and the climb only moderate. With a crew of nine, five tons of mail, and a fair number of passengers, the range will be 2700 miles.

The long hull seems to have a more pronounced V-bottom effect than is usual Dornier practice and it has but one step situated under the rear edge of the wing. As is customary in Dornier construction, there are no tip floats, huge sponsons at either side of the hull giving the required lateral stability. These sponsons naturally act as lifting surfaces in flight.

We have been speaking above of the main wing. Do. X may almost be termed a triplane, since in addition to the main wing of 150 feet span and the sponsons, there is also an auxiliary wing, some four feet above the main wing, of rather greater aspect ratio than the main wing itself, which serves to complete the engine bracing and also contributes to the total lift.

Grover Loening (right), designer of the single-wheel amphibian, and his test pilot, B. Allison Gillies

The six engine nacelles are mounted directly on this auxiliary wing. Each nacelle carries two engines in tandem, with two propellers, one a tractor and one a pusher. Directly under each engine nacelle there is a streamlined support, broad enough for a man to get into comfortably, which runs to the main wing. Inside this streamlined support there is a ladder which leads up to the engine nacelle. The main wing, since it is externally braced by struts running from the sponsons, is not unduly thick, somewhere around three feet, we gather. We doubt therefore that it is intended that the mechanic should crawl inside the wing to the engine nacelles. But each of the supports for the nacelles has not only an inside ladder, but also a convenient door on either side. It should be comparatively easy to climb from the engine room into the two central nacelles, then get out on the wing, and by hanging on to the bracing wires pass on to the next engine support. On this point our curiosity probably runs ahead of our knowledge.

What is definite is that there is a single engine room, with a chief engineer and four mechanicians. In this room there are innumerable controls and instruments, for all the world like the control room of a power house. Here there is ample space and head room for the men in charge.

The propeller diameter appears rather small for the power developed, but this has been made possible by the use of four-bladed propellers. The propellers are really two superimposed two-bladed propellers and are built of laminated wood.

The hull has three decks. The middle deck has a passenger compartment, 80 feet in length and 16 feet in width, with accommodations for one hundred passengers. There are individual sleeping compartments, comfortable chairs, baths, a reading room and a well appointed restaurant. Towards the rear of this deck there is an ample electric kitchen. With 100 passengers and baggage, the range is only 800 miles. The sides of the hull are provided with the traditional port holes of marine practice.

The lower deck is to be used for baggage, stores, and fuel. The upper deck is divided into three compartments. The front compartment carries the pilots and navigating officers, who have good vision through windows of a more land-like appearance. The middle compartment is the engine room. The rear compartment houses the wireless operators and equipment.

The balancing of the controls in a flying boat of this size is quite an undertaking. Apparently little auxiliary surfaces are mounted above each control surface and these auxiliary surfaces provide an opposite turning movement about the hinges which lessens the effort which the pilot must exert.

Perhaps our readers will gain more accurate knowledge from the photographs themselves. With them we shall await eagerly more details of this remarkable craft which by virtue of its size, carrying capacity, complete equipment, and crew should have a high degree of seaworthiness. It is the intention of the Dornier Company to make a transatlantic crossing, with stops at the Azores and the Bermudas.

A Single-wheel Amphibian

GROVER LOENING, the well-known aeronautical engineer, has for many years been building various successful types of amphibians. His latest design is of interest because it provides an amphibian gear of the simplest and lightest type for the small, conventional single pontoon plane of low power, and brings the amphibian into the moderate price range.

The development of this new, single-wheel amphibian has been continued over a fairly long period, and in complete secrecy. The first trials, recently made, were entirely successful.

The seaplane to which the single wheel amphibian gear has been applied is a Moth biplane, with single float, and equipped with the Cirrus Mark II engine.

The duralumin float as applied to the Moth is 17½ feet long and 30 inches wide. Two side floats are used, placed under the outer wing struts.

The single wheel mechanism raises and lowers in a pocket in the hull in direct combination with doors that open and close the pocket, according to the position of the wheel. The shock absorption is taken on rubber disks in compression. The raising and lowering mechanism is of a new type consisting of two toggle levers so hinged that when the wheel is out, the toggles are locked for carrying the load. With the aid of balancing springs, the mechanism is so readily operated that it takes only one second to raise or lower the wheel by means of a lever conveniently located in the pilot's cockpit. Only a total of 80 pounds has been added to the weight of the Moth as a landplane by the addition of the floats and amphibian landing gear, and the speed of the landplane has been reduced by only four miles per hour.

In the tests at Port Washington, the little ship balanced readily on the single wheel, somewhat after the fashion of a bicycle. When at rest on land, struts on the wing tips serve to hold the plane in position.

Mobile Mooring Masts for Airships

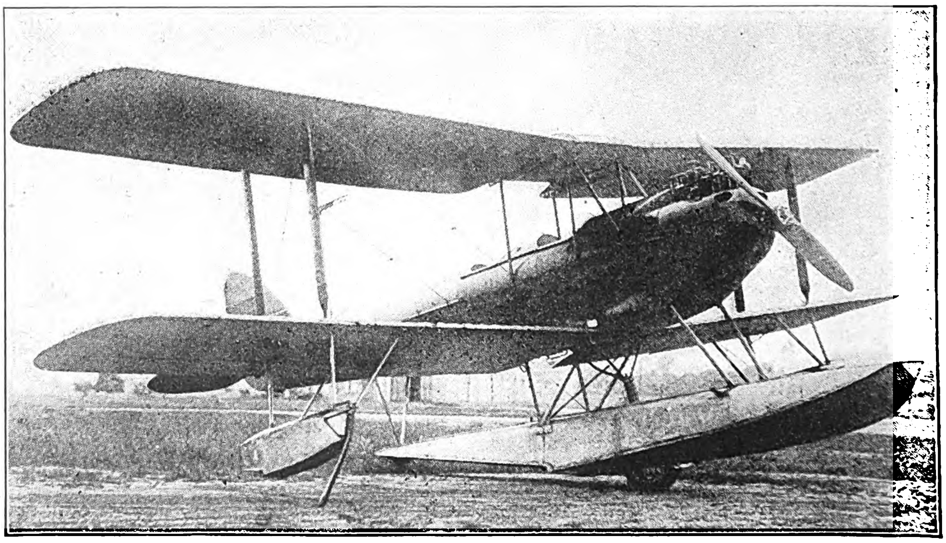
IN a paper, presented before the Society Automotive Engineers, Lieutenant Commander C. E. Rosendahl, U.S.N., reviews the interesting subject of mooring-mast design and gives the first information available on some extremely valuable equipment developed at Lakehurst, to facilitate the ground handling of airships. The perfection of the technique for this work is, of course, one of the most important phases of airship operations, if they are to become practical vehicles of transportation.

Perhaps our mechanically inclined readers will be interested in reviewing the method of securing an airship to the mast.

The longitudinal members of an airship come together in a strong cap at the bow. In this is secured an axial steel tube housing a strong spindle mounted in bearings. A steel mooring cone is mounted on the end of the spindle, hinged on a pin running across the axis of the airship. At the top of the mooring mast there is a steel cup, which will fit the ship's cone, and which is mounted on a radial bearing. When the ship is moored the cone is locked in the rotating mast cup. The ship has thus three degrees of freedom. She can swing around the mast like a weathervane. She can roll, because the spindle is free in its bearings, and she can oscillate up and down in a vertical plane about the athwartship hinge.

With a high mast, the vertical oscillations may assume dangerous proportions; a variety of stabilizing methods have been tried, but none are absolutely free from objections.

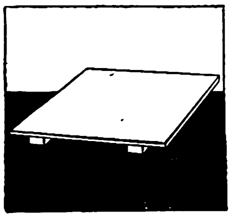
Since the air is less quiet a few hundred



The single-wheel amphibian gear applied to a Moth biplane

How Presdwood is used in making the cores for engine cylinder castings

Only those who have tried out Masonite Presdwood can really understand how a grainless wood board can improve products and lower manufacturing costs. That is why a sample of Prestwood is gladly sent, without obligation, to executives who are interested in improved production methods.



FOR CORE TRAYS IN FOUNDRIES

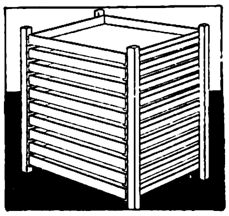
In many of the finest foundries, where white hot streams of molten iron are being transformed into automobile cylinder blocks, you will find cores for the molds being baked on grainless wood boards of Masonite Presdwood. They are boards which are highly resistant to warping, even when exposed to wet sand cores and scorching temperatures that run up to 450 degrees.

The Lakey Foundry and Machine Company of Muskegon, Michigan, is just one such progressive concern where Presdwood is being used for this purpose. In competition with steel plates and other materials, this grainless wood was adopted because of its lightness, strength, hardness and smoothness.

For simplified manufacture

Industry after industry has turned to Presdwood to improve products, lower costs or simplify production methods. Presdwood is used for starch trays in candy factories. It makes sturdy sides for specialty shipping containers, outer panels for incubators and iceboxes, hulls for fast speed boats, weather resisting road signs, side panels for motor truck bodies, light toys, bedroom screens and a score of other useful articles.

Presdwood has no splintering edges to mar the finished work that is done in a factory or to bother the mechanic who uses it around the home. This grainless wood can be punched, die cut, milled or sanded. It can be sawed, planed or cut with a knife. Presdwood does not split or crack; is chosen by production executives, enjoyed by men and boys who like to make things.



FOR STARCH TRAYS IN CANDY FACTORIES

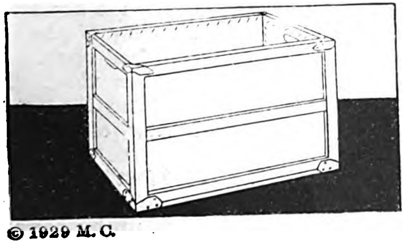
In buildings and homes—for paneling

Presdwood panels fine homes and buildings of the most modern kind. It takes any commercial finish or can be left just as it comes, for it is naturally attractive as well as moisture resisting. It makes decorative floors and backgrounds for show windows, is used at Hollywood for the construction of moving picture sets. There are, in fact, so many striking and varied uses for this grainless material that a booklet has been written which describes eighty of the most interesting uses and attractively illustrates many of them.

The booklet and a sample of Masonite Presdwood may help you find a way to use this grainless material to cut production costs or improve a product. The sample and booklet are yours for the asking. It takes but a postcard to bring them.

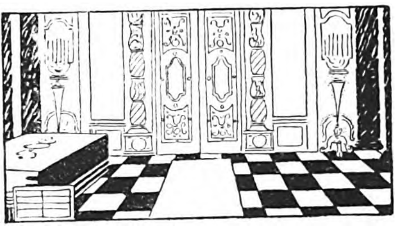
MASONITE CORPORATION
Sales Offices: Dept. 742, 111 West Washington Street
Chicago, Illinois

FOR SPECIALTY SHIPPING CONTAINERS



Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR MOVIE STUDIO SETS



© 1929 M. C.

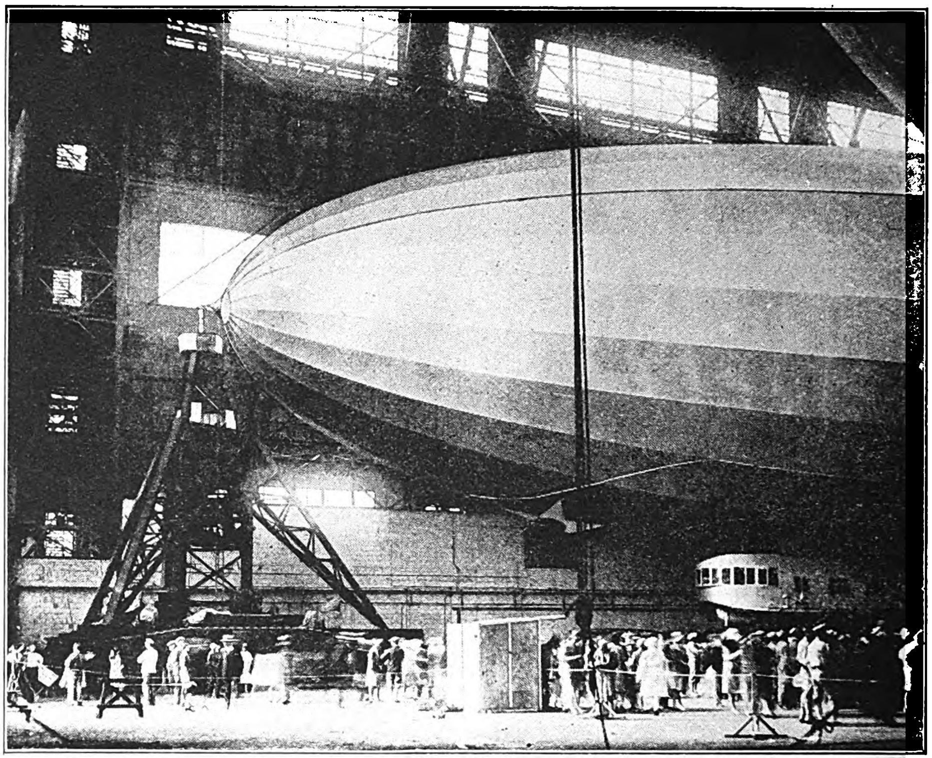
feet off the ground than at the earth's surface, and since vertical currents cannot exist near the ground (they cannot blow into and out of the ground), the next logical step for the airship engineers was to devise a stub mast.

Stub-mast equipment consists of a short mooring mast to which the nose of the ship is secured, and a stern carriage to which the rear end of the airship is attached. The first stub mast consisted of a pine timber, about 12 inches in diameter and 60 feet long, which had originally served as a radio tower. The first type of stern carriage consisted of a large airplane landing wheel fitted with shock absorbers and a platform which could be quickly attached to the after-car of the airship. Around the stub mast there was a circular dirt path for the wheel. This seemingly crude equipment served its purpose very well. Eventually the stern carriage was made capable of exercising a downward pull of between two and a half and five tons, and of resisting all attempts of the ship to swing up or down.

The next step was to make the stub mast movable, so as to avoid the use of great numbers of men in moving the airship to or from the hangar. A mobile stub mooring mast has now been constructed at Lakehurst. It is a three-legged steel structure having a triangular base 60 feet on each side, mounted on three Athey truss wheels, so that it may be towed. The upper mast portion is made telescopic. This mast is complete with its own electric generating units, fuel and water-ballast storage, pumps, and mooring winches. By using this mast at the bow, a great proportion of the ground crew is made unnecessary.

It is proposed to eliminate more men by means of a series of endless wire-bridles running from certain reinforced parts of the ship to a rigid trolley system running on rails parallel to the hangar.

The navy is to be congratulated on the ingenuity shown in these devices.


The mobile mooring mast for dirigibles in the hangar at Lakehurst

"Aviation Law"

"AVIATION Law" is an authoritative text book, written by Henry G. Hotchkiss, and published by Baker, Voorhis and Company, New York. It contains the texts in full of such important documents as the International Convention of 1919, Air Commerce Act of 1926, Air Commerce Regulations, et cetera, and of important statutes, both Federal and State, dealing with aviation.

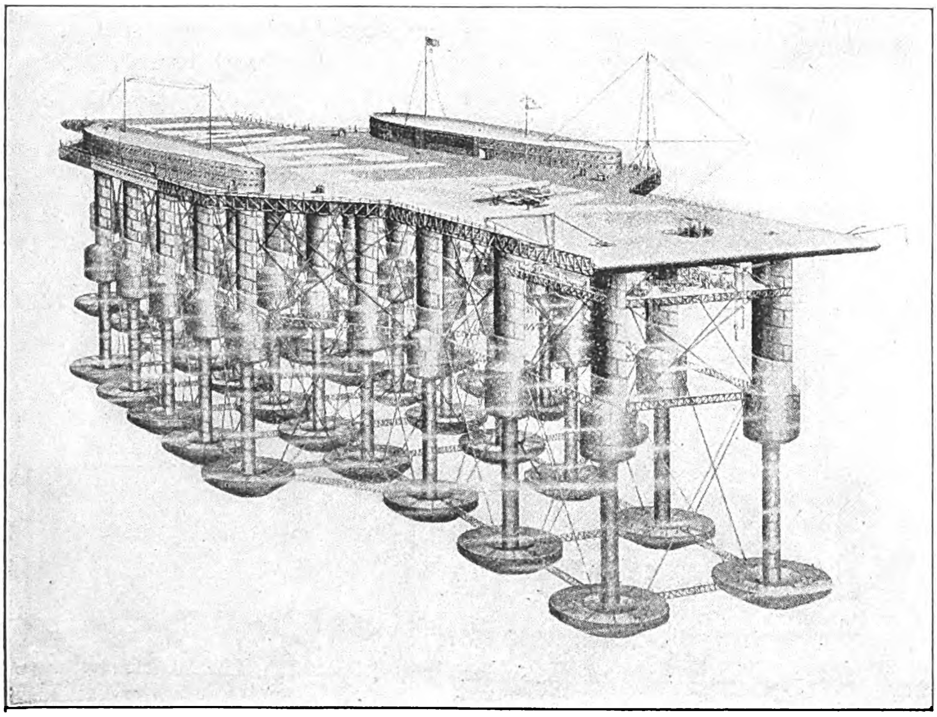
While evidently written for the lawyer, this book contains a great deal of easily understood and interesting material for the layman. The growth of aviation has brought out some curious legal difficulties. The early English rule, for example, stated that "he who possesses the land possesses also that which is above it." Under this rule any aviator flying over a farmer's land would be trespassing.

But our learned judges are disposing of those maxims which no longer apply. Here is an opinion of Judge James C. Michael of Minnesota: "The air, so far as it is in direct relation to the comfort and enjoyment of the land, is appurtenant to the land and no less the subject of protection than the land itself, but when, as here, the air is to be considered at an altitude of 2000 feet or more, to contend that it is a part of the realty, as affecting the right of air navigation is only a legal fiction, devoid of substantial merit."

Quite a number of airplane operators will want to read this book.

Pneumatic Tubes at Croydon

THE G. & G. Atlas Pneumatic Tube Company gives us an interesting sidelight on operations at the modern airport. At the great Croydon airport in England there is a central operating station at which all the radio messages giving weather reports, the speed and position of all planes, et cetera, are collected. Orders are issued from this central operating station. To avoid errors and delays the station is connected with all other parts of the airport by underground pneumatic tubes through which messages pass to and fro the entire 24 hours of the day.


A detailed view of the projected Armstrong mid-ocean airport

More on the Armstrong Seadrome

E. R. ARMSTRONG, working on his seadrome which is projected to serve as a mid-ocean airport, is carrying his design steadily forward. Owing to the fact that all the buoyancy-producing elements are submerged far beneath the surface of the waves, complete stability of the seadrome may be safely reckoned upon. Experimental tests confirm this view. The design of the seadrome from the purely aeronautical point of view offers many complexities.

The "field" will be 1200 feet long and 400 feet wide at the center. Certain portions of the space will be taken up by hangars, hotel, restaurant, and machine shops.

New INDUSTRIES
follow in the footsteps
of
TIMKEN BEARING
EQUIPPED
HC

© 1929, THE TIMKEN ROLLER BEARING CO

EQUIP machinery with Timken Bearings—and Waste is brought to a dead stop while Industry sweeps ahead with giant strides. Friction becomes a mere fraction, power leaps into action, depreciation swings sharply to a minimum, lubrication costs are negligible.

Such are the benefits symbolized by "Timken Bearing Equipped"—*the one bearing that does all things well* because of this exclusive combination: Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

With millions of horsepower and billions of invested capital involved, Industry, Agriculture, Mining and Transportation cannot longer tolerate Waste when the solution is so clearly defined in the one phrase—"Timken Bearing Equipped".

Everywhere this is the guiding symbol dividing the modern from the obsolete, the deciding factor in a huge replacement program which surges forward, bringing new savings *wherever wheels and shafts turn.*

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Stone Carving by Sand Blasting

"ART is long, and time is fleeting," particularly if one's art is of the sort that will endure despite centuries of exposure. When the sphinx and the pyramids were built, there were men in Egypt who were both great and famous. The world has forgotten the "immortals" of that early day, but the sphinx and the pyramids have lost none of their glory. Workers in stone have always had the satisfaction of knowing that their handiwork would have more than a transitory existence. In all ages, they have sought to engrave life-like designs of flowers, leaves, and other configurations having an artistic appeal. However, because of the hardness of the stone, it has heretofore been practically impossible to produce sharp-edge relief carvings of such designs as leaves and flower petals.

Art
Carving
By Luce

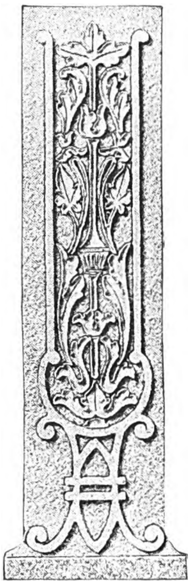
Above and at right: **Examples of the exquisite work in stone carving accomplished with sand-blasting**

With the advent of high-powered saws, cutting and surfacing machines, and the use of "sand-blast" for decorative work, stone cutting has undergone a revolutionary change. By the development of a process recently patented, the long-sought effect of artistic ornamentation in relief has been attained. The inventor, George R. Philip, is associated with Cross Brothers Company of Northfield, Vermont, one of the leading producers of granite memorials.

By means of the new process, such designs as flowers and leaves are sand-blasted in stone, with an amazingly realistic effect. The carvings are distinguished by sharp edges in relief and vertically cut "sinkages." Two-tone effects in the granite are also achieved with a variation of the Philip process.

To produce a sand-blasted relief carving, the finished face of a stone of the desired size is first coated with a rubber-like substance, usually a mixture of glue, water, and cane molasses. When the coating dries, it resists the sand blast so effectively that the abrasive cuts the design in the granite only where the coating is removed. A single cut or slit is made around the border of flowers, leaves, and other configurations, and then the coating is removed where the figures are to be formed. By applying a sand blast, the figure is cut as a sinkage to the desired depth.

If a flower is to be formed, a sharp edge may be provided by filling the cut or sinkage with the same material used previously as a coating. A very narrow outline is then sand-blasted out, and the background or other portions to be removed are exposed to the cutting action of the sand. The effect produced is that of a raised design with sharp edges similar to those of the natural leaf or flower petal. On account of the extreme hardness of granite, there is but little danger that the ornamentation in relief will break or chip off. It is claimed that hammer and chisel artisans of the old school have never created such beautiful effects as those produced with this method and, furthermore, that finer work can be done by a day-laborer using this process, than with the most painstaking endeavors of a skilled stone cutter.



New Synthetic Rubber Is Made Largely of Waste Materials

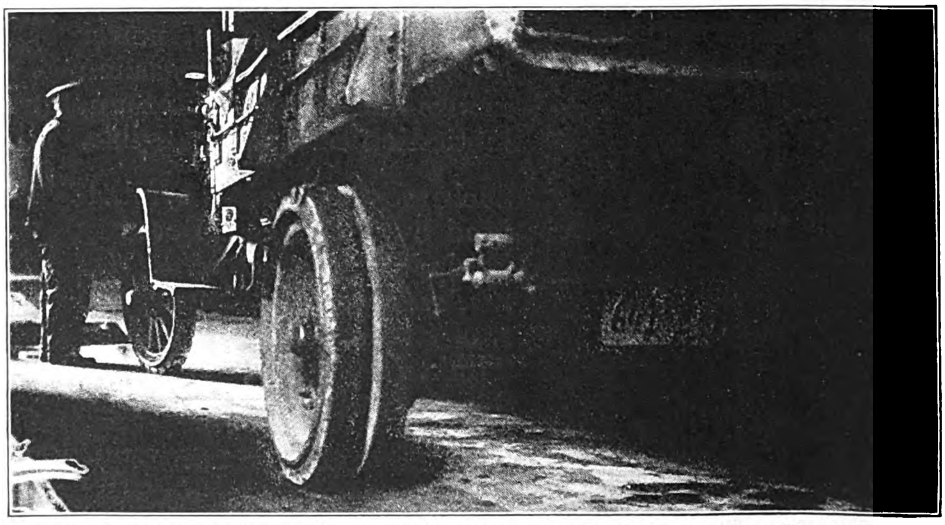
THE United States consumption of crude rubber and reclaimed rubber during 1928 has topped the volume for all time. Crude rubber to the extent of 437,000 long tons, and 223,000 long tons of reclaimed rubber are the Department of Commerce's official figures showing an increase in the use of reclaimed rubber of 17.7 percent over 1927. Of this volume, Ohio, the leading State in rubber consumption, used 55.39 percent of the total crude rubber, and 45.37 percent of the reclaimed rubber.

The world's production of crude rubber for 1928 approximated about 700,000 tons; of this amount it is estimated that about 17 percent was used in the manufacture of solid or hard rubber items.

With the need of a domestic production to replace rubber, there has now entered into the industrial rubber world a new product manufactured by the Synthetic Rubber Company of West New York, New Jersey. Following several years research and experimental work, in the production end of the rubber industry, Charles Cholerton, Jr., a practical manufacturing engineer, achieved the present formula.

Some two years ago, Cholerton, working over a kitchen stove and using brittle cast-iron molds, made eight solid truck tires before his molds broke. During July, 1927, six of these tires were put on a truck owned and operated by the City of New York, in the Street Cleaning Department. This truck has been in continual service with the exception of periodical short intervals for minor repairs. It has been variously used for hauling, and lately has been equipped with a dump body.

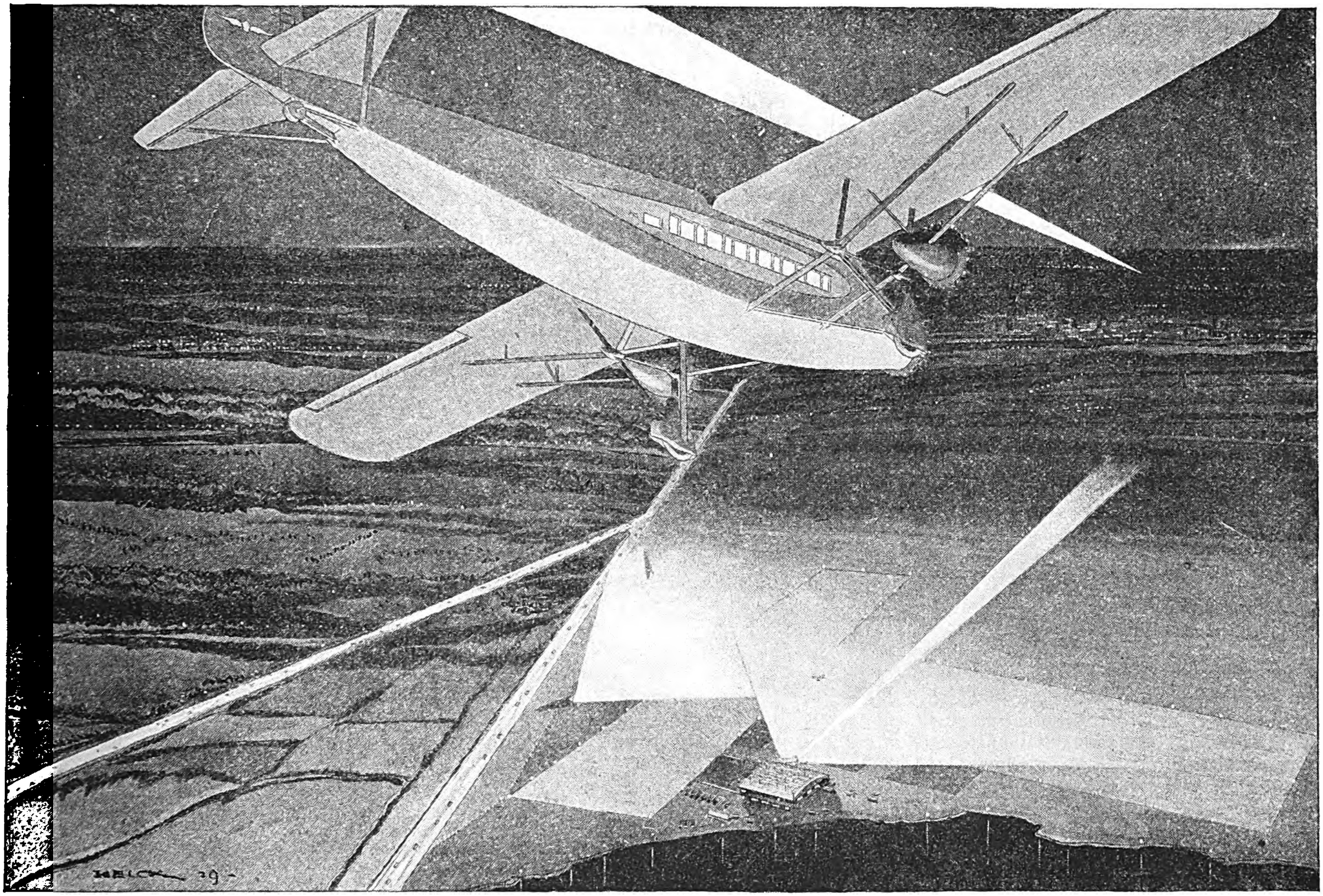
After several months' use, one of the six tires used on this truck, left the rim. The remaining original five tires, together with a genuine rubber tire of standard make (fitted in place of the one tire above referred to) are still in daily operation and it



A view of one of the synthetic rubber tires described above, after 21 months of service. It is still in first-class condition and shows few signs of wear

• WHAT WESTINGHOUSE IS DOING TO MODERNIZE TRANSPORTATION

DRAWN FOR WESTINGHOUSE BY C. PETER HELCK



AT NEWARK, N. J., AMERICA'S FINEST AIRPORT LIGHTING HAS BEEN INSTALLED BY WESTINGHOUSE

Blazing the sky-riders' trail

Through miles of blackness sweep the gleaming shafts that guide night flyers to the welcome of light-bathed landing fields. Flying, which used to be thought of as dare-deviltry, is now "transportation"— safe, reliable, necessary — carried on by night as well as by day. And Westinghouse electrical equipment is an integral part of its safety and reliability.

To blanket broad fields with brilliance free from confusing glare or dangerous shadows, skilled Westinghouse engineers have designed giant projectors, some of them a million candlepower in strength. Wherever they are installed, any airplane can swoop down from darkness into daytime safety for a perfect landing.

Many a cloud-strewn lane, traveled nightly by carriers of the air-mail, is marked by the blaze of beacons, far removed from ordinary power supply, but provided with unfailing current by means of Westinghouse individual electric plants which can be installed anywhere.

On the planes themselves, moreover, are propellers of tough Westinghouse Micarta, the material that furnished propellers for the "Southern Cross," the "Question Mark," and many another plane which has made aviation history. In airplane factories, also, Westinghouse is a part of aviation; Westinghouse motors give power to the tools that turn out parts for finished craft — boring, grinding, shaping, polishing, assembling. As aviation expands, Westinghouse will be found serving the future needs of flying with the same skill and co-operation given to past developments, not only in aviation but in all branches of electrification for homes, mines, mills, farms, power plants, and transportation.

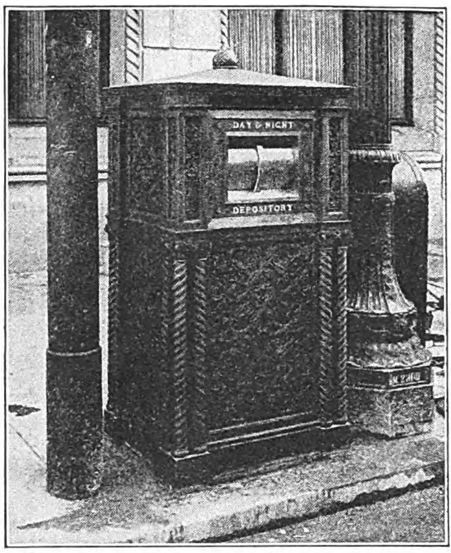
Westinghouse Electrification
Appliances Apparatus
Wiring
WESTINGHOUSE ELECTRIC

The Sign of a Westinghouse Dealer

Westinghouse

is interesting to note that of the two front tires, one standard make rubber with 11 months' service and Cholerton's tire with 21 months' service are at the present time both in first class condition and both presenting equal appearance as far as wear and tear are concerned.

The remaining four tires on the rear wheels after many months' service give general favorable appearance, two of them showing no imperfection or damage of any kind, the other two having abrasions and cuts reasonably to be expected after such length of service. The two last mentioned tires are on the outside edges of the wheels and the cuts referred to were probably caused by short turns against curbstones.



Bank depository for the convenience of motorist-depositors

Cholerton's process is the result of burning one of Nature's common wastes in a novel chemical atmosphere. This, a lime compound, comprises about 50 percent by weight of the finished product. The other 50 percent is made up of metallic chemicals, mineral and vegetable gums and oils, all of which are items of everyday commercial use. The resultant colorless mixture, powder-like in form, and not in the least resembling rubber, is pressed into molds, and heat treated under pressure.

The combination of temperatures and pressures induces chemical reactions with the result that the product has all the physical qualities of rubber. It is resilient, elastic, and acts like molded rubber. It is water-proof, oil-proof, and gasoline-proof as well as acid and alkali-proof. Unlike rubber it does not deteriorate with age. The plentiful raw materials are cheap, as are the gums and chemicals.

Solid truck tires, paving blocks and floor tilings can be manufactured and sold at a price comparable to any on the open market of equal wearing properties, and these will be the company's first commercial productions. There is a growing demand for paving blocks, and the Synthetic Rubber Company's new process will make possible the paving of streets, bridges, bridge approaches, and tunnels, and at an attractive price.

Banking by Auto, Latest Convenience

BANKING by auto is the latest innovation of the Central National Bank of Oakland, California, which recently installed a curb depository device to enable its customers to deposit money and valuables any time during the day or night without entering the bank or, indeed, without leaving one's car. It is said to be the only device of its kind to be used by a bank anywhere.

This curb depository was made necessary because of the increasing difficulty of parking cars in the vicinity of the bank. It consists of an attractive bronze box, 5 feet high by 28 inches wide, built on the edge of the sidewalk in front of the bank building. The depositor need but halt in front of this box, and without leaving the car insert his deposit and bank-book, in a slot opening, in the same manner that he would drop a letter in the corner mail-box. The deposit is precipitated through a 22-foot chute, and is received in a vaulted receiving chest inside the bank.

Many banks now use night depositories built in the wall for use of their customers who desire to make deposits after banking hours. The device adopted by the Oakland bank is unusual in that it is being used during the regular banking hours as a convenience to those who find it difficult to park their cars in the central business section where the bank is located.

Above and at right: Views of the new shock-proof X-ray apparatus recently installed in a hospital

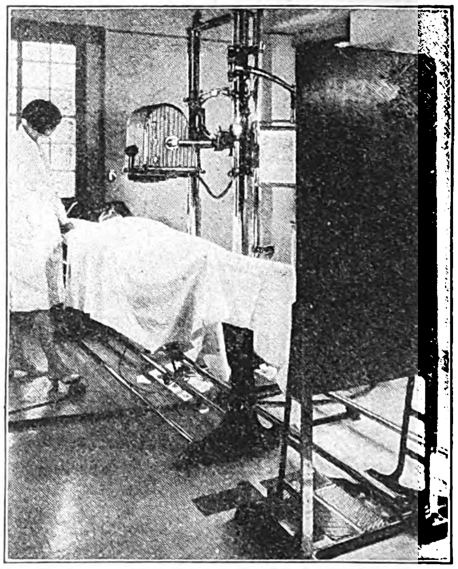
The bronze depository, the steel chute, and the steel receiving chest are wired for burglary protection. No key is needed to open the receiving slot. Several times during the banking day the receiving chest is opened by two tellers, the deposits checked, and receipts sent to the bank customers.

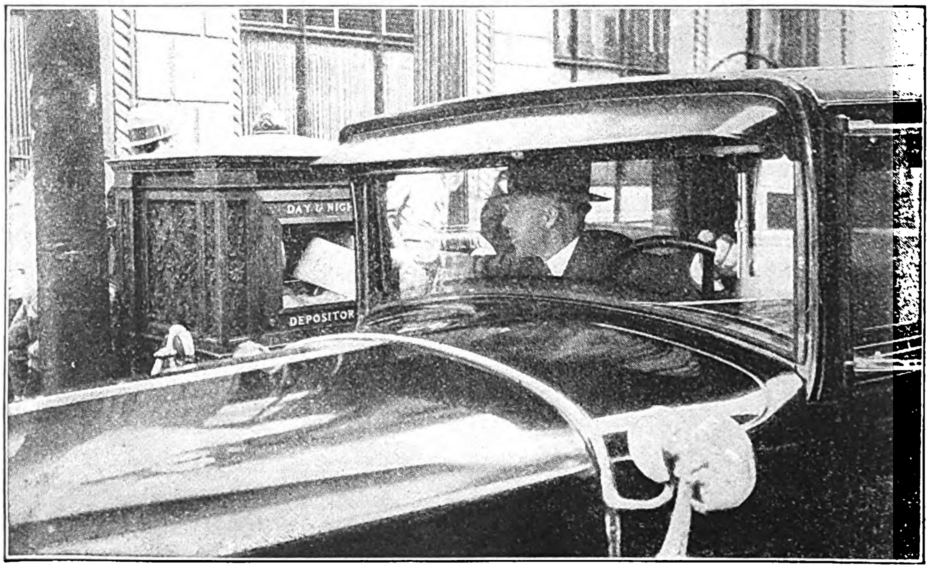
Large industrial concerns in Oakland are taking advantage of this device to make their daily deposits, which run into the tens of thousands of dollars. Each deposit is covered by insurance, according to a special plan worked out by the bank with one of the largest international insurance companies. It is being used also by Oakland people to deposit their jewels and other valuables during the night hours after attending formal functions, relieving them of the necessity of carrying the valuables with them and exposing them to the dangers of hold-ups.

Shock-Proof X-ray Apparatus Installed

A NEW type of X-ray apparatus, completely insulated in oil and with all high-voltage wires completely eliminated, has been announced by the Victor X-Ray Corporation, a General Electric organization, with the installation of the first of the new shock-proof machines in the Neurological Institute, New York.

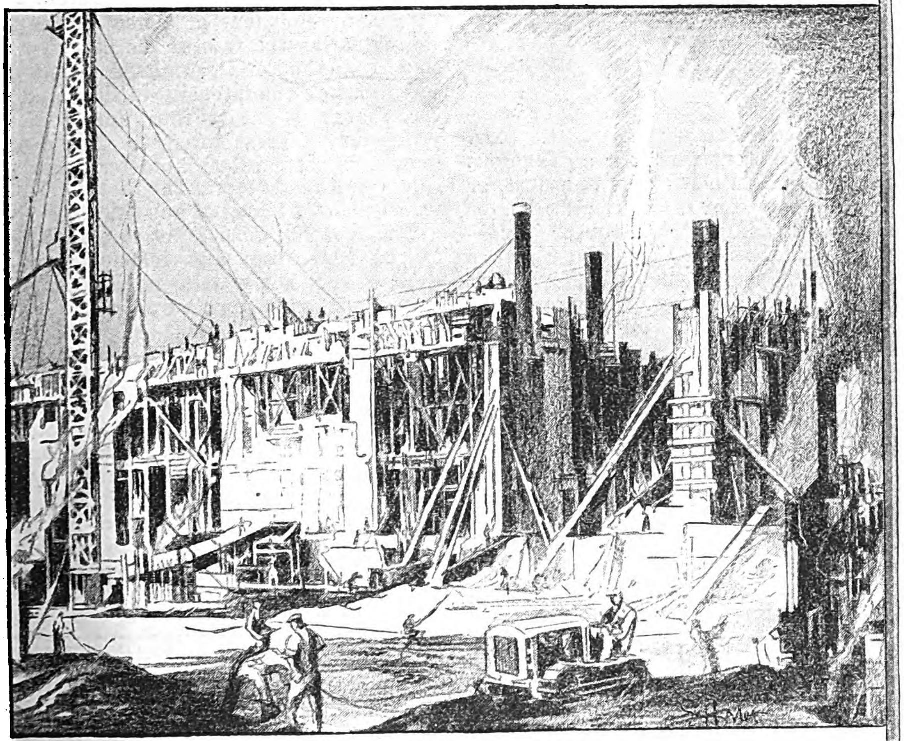
(*Please turn to page* 357)



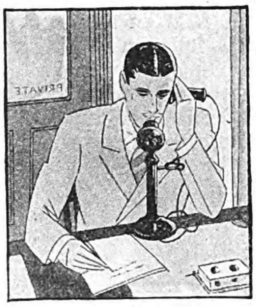


The curb bank depository in use

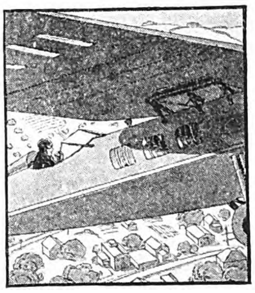
More *and still more* telephones for tomorrow



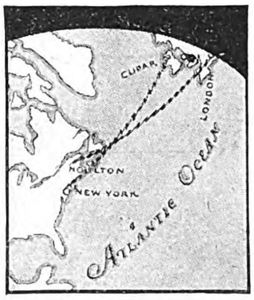
In homes



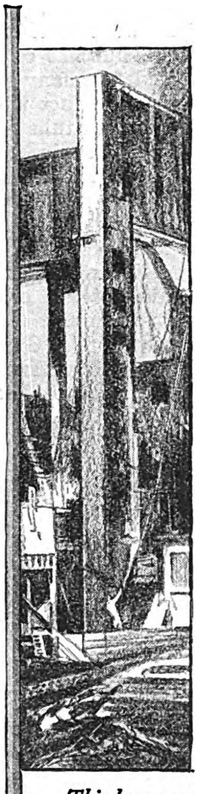
In offices



In airplanes



Across the ocean



This busy scene is typical of Western Electric growth at Baltimore, Chicago and Kearny, N. J. It is growth made necessary to provide telephone apparatus whenever and wherever needed.

Your voice starts new factories a-building

Day by day, the telephone becomes a more significant factor in social and business intercourse. As a means of communication on land and across the ocean, its use grows steadily and it is soon destined to become an accepted adjunct to travel in the air.

More and more equipment will be needed—telephones by the million, copper wire by the millions of miles, parts and accessories ranging from delicate springs to giant reels of cable, from the simple transmitter mouthpiece to the highly complex telephone switchboard.

To meet this program of expansion Western Electric's manufacturing facilities are being doubled. Huge additions to plants at Chicago and at Kearny, N. J.—a new factory at Baltimore—all this is evidence that however great the demand for telephones in 1930 or 1940, that demand will be satisfied.

Western Electric

MAKERS OF YOUR TELEPHONE

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association *and of* Hygeia

Accidents in Bathing

A TRIP through any anthropological and ethnological museum reveals the fact that the bath tub is not a modern invention, but has certainly been known to mankind for many years. This, notwithstanding the fact that legend insists that the first bath tubs were introduced in the United States in the city of Cincinnati about the middle of the 19th Century. Of course, this argument must take into account the difference between the bath tub that is filled with water carried from a long distance in buckets and the modern tub with hot and cold running water constantly on hand.

Recently, Dr. Guy Hinsdale assembled a list of the various causes of accidents that occur to people while bathing. They include such mishaps as falls on slippery places in the bathroom, falls on getting into or out of the tub, epileptic convulsions while in the tub, also unconsciousness due to sudden heart failure, brain hemorrhage, drowning in the tub, scalding in the tub, burns from steam in the Turkish bath, electric shock, death from escaping gas in the bathroom, drowning in various pools or plunges, and accidents from the accessories used in connection with the bath tub.

Again and again newspapers record the drowning of children left by mothers in the tub while they attended to some household duty or answered the ring of a door bell. Again and again deaths are reported due to the carbon monoxide gas from inefficient gas heaters or from heaters without a proper vent.

Electric shocks while in the tub or bathroom are exceedingly frequent. Dr. Hinsdale points out that it is a dangerous thing to touch an electric bulb, socket, or even a push button or an electric heater while standing in the bath tub or in contact with it. Bulbs, sockets, electric wires or apparatus should never be installed within reach of a bather. Innummerable instances are available of deaths from electric shock of persons who have attempted to use artificial vibrators, ultraviolet ray apparatus, hair curlers, or electric heaters while in the bath tub.

Also sudden changes from very hot to very cold water or vice versa may throw a strain on the blood and circulation beyond the capacity of the tissues to bear.

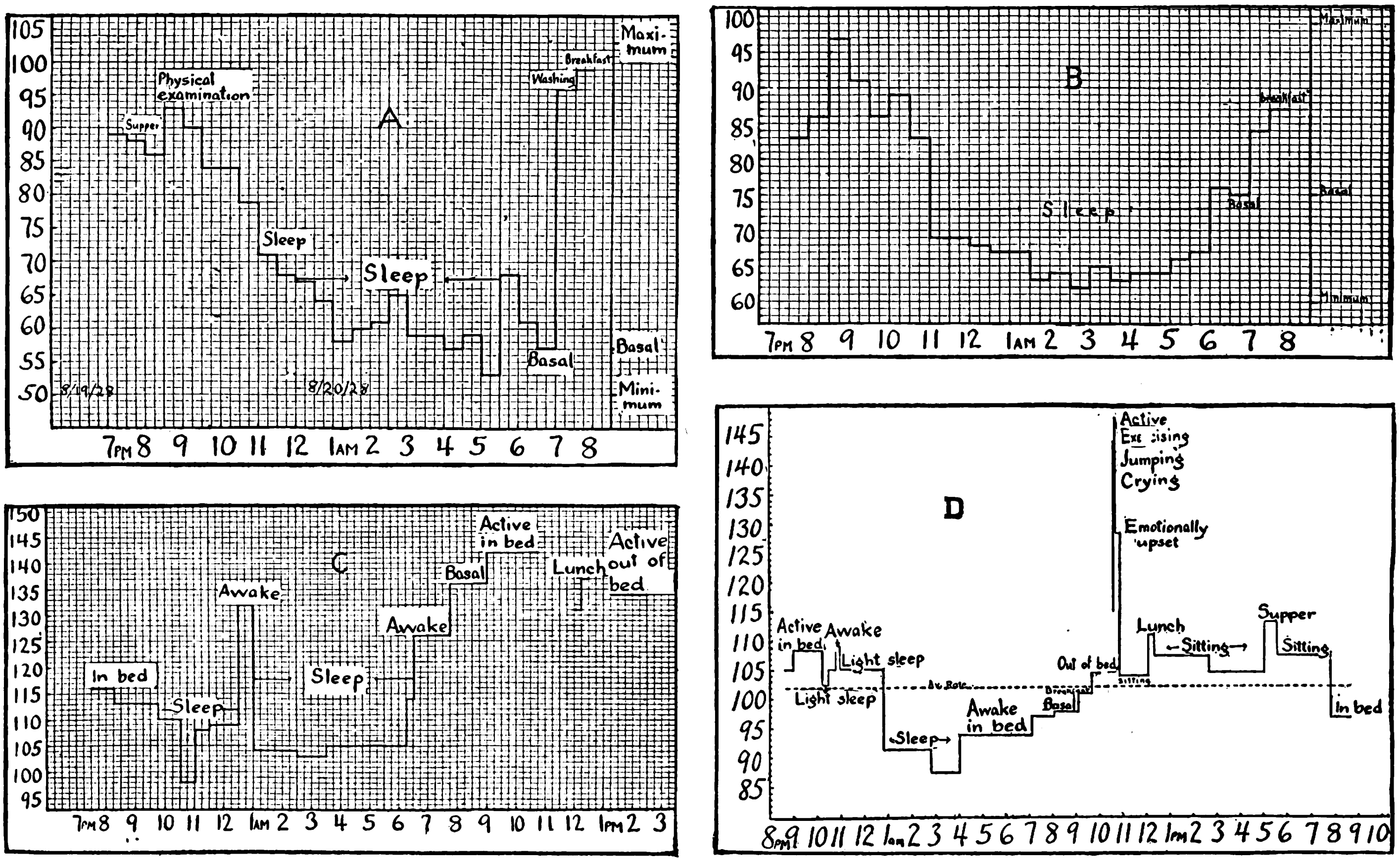
History records the death of Marat while in the bath tub when he was stabbed by Charlotte Corday. This type of accident is not included in the list compiled by Doctor Hinsdale.

The Heart Rate During Sleep

THE development of a new device for measuring the rate of the heart by an electric method has permitted recent observations on the intensity of sleep and on the change of heart rate during sleep, which are of great interest. The device known as the cardiotachometer automatically counts and records the beats while the person follows his usual activities.

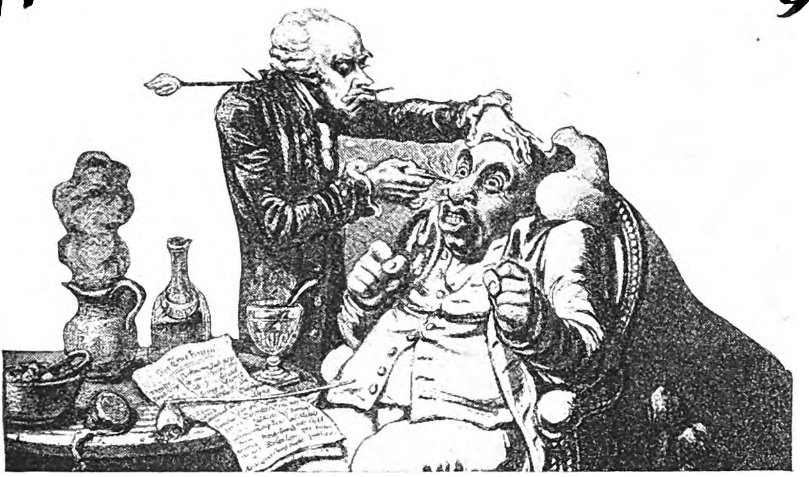
The investigations indicate a reduction in the heart rate and relative stability during sleep, but a tremendous variability of the heart rate during waking hours. A simple movement, such as putting the hand to the head, will speed up the heart rate, whereas during sleep the rate is relatively low and steady. By the use of the device, it is found that the normal heart rate of a person may vary from 55 during sleep to 100 during activity, as shown by the accompanying charts.

The rates were also studied in many diseases and the charts for two cases indicate how the heart rate may vary in various conditions.



Charts of heart rates of various individuals under different conditions. *A.* Normal heart rate in male. Total time 12 hours 56 minutes. Total heart beats 55,845. *B.* Normal heart rate in female. Total time 12 hours 53 minutes. Total heart beats 57,603. *C.* A woman with exophthalmic goiter and a high basal metabolism. Heart rate ranged from 149 to 142 during day and dropped to 98 during sleep. *D.* A girl, aged 19, with heart disease after an attack of chorea. The mitral valve was narrow. The heart rate varied from an average of 95 during sleep to 145 when excited. These charts were made with a new electrical recording device, the cardiotachometer

Suppose your doctor did this to you



Perkins's Metallic Tractors—which in this case are being exercised to cure a "jolly" nose—are drawing jets of flame from the organ in question

Suppose if you had a bad cold you were liable to be put in a hospital bed with four or five other people—dying, perhaps dead, of everything from typhus to childbirth. ***Suppose*** when you had a slight wound the doctor poured boiling oil in it to avoid infection.

Suppose during an operation you were held struggling on a table by burly attendants instead of being given an anaesthetic. ***Suppose*** when you fell ill your doctor dosed you with antimony, bitters, rock salt, violets, beet root, cinnamon, cochineal and aloes—and plastered you with Burgundy pitch and pigeon dung.

Horrible Suppositions—yet all these things and many more might have happened to you in the days before medicine and surgery became what we know them as today. The strange and terrible story of the attempts at curing mankind has been finally set down in one of the most fascinating books ever written for the general reader.

DEVILS, DRUGS and DOCTORS

by Howard W. Haggard, M. D.

Professor of Applied Physiology at Yale University

Now for the first time you can read the fabulous story of medicine, written so that you can easily understand it, in one volume by one of the greatest authorities on modern medicine.

You can read of the extraordinary medical and surgical practices of other ages—in Egypt and Greece, in Europe of the Middle Ages, the Renaissance and the earliest days of modern medicine—all the superstitions and horrors from which we have finally been freed.

Illustrated with 150 old engravings and woodcuts—alone worth the price of the book—this extraordinary account of the conquest of superstition in medicine will enthrall you throughout with its wealth of anecdote and out-of-the-way information. Thousands of facts you never dreamed of are assembled before you—things you should know yourself—many things you would like to be able to talk about. Sign the coupon now and get the book for five days' free examination.

FREE EXAMINATION COUPON

HARPER & BROTHERS S.A. 10
49 East 33rd Street, New York City
Send me for 5 days' free examination one copy of
DEVILS, DRUGS AND DOCTORS, $5.00
☐ I will remit $5.00 within 5 days, or return the book.
☐ I enclose check. ☐ Send C. O. D.

Name......................................

Address...................................

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Sionon—a Sugar Substitute

NEW sugar substitutes have been sought for a long time because saccharin and dulcin are not permanently satisfactory for those who must avoid sugar. As yet, however, only a very few of the many sugar substitutes have proved valuable. Recently, a German manufacturer has placed *d*-sorbite upon the market, under the name of Sionon, as a sugar substitute. Sionon has a sweet taste, which, according to the reports from the medical clinic of the University of Wurzburg, was distasteful to none of the patients. The tolerance was very good so long as the quantity did not exceed 70 grams and the "sugar" was not all given at the same time. Sionon could also be used in condiments, although it must not be heated above 60 degrees, Centigrade. Its general applicability will depend primarily upon its price.

Petroleum Products in Insecticides

THE continuous search for cheaper and more effective methods of controlling insect pests has given the chemists a very enticing problem. To one not in intimate contact with entomological problems a general spray mixture for all troubles—a cure-all—would seem to be the product to develop. Upon close study of the variables in spraying the many species of destructive insects, a product that would increase markedly the efficiency of any specific control would be well worth while.

In view of this fact a thorough study of the application of the oxidation products of petroleum to the insecticide field has been conducted by M. I. Inman, Jr., of the Kay Laboratories, Inc., West Nyack, New York, in co-operation with state entomologists and the Crop Protection Institute. As a result of this work a definite procedure in attacking soft-bodied sucking insects, such as aphis and leaf hoppers, was developed.

In a recent issue of *Industrial and Engineering Chemistry*, Mr. Inman describes results obtained by the addition of chemically treated oxidation products of Pennsylvania gas oil to a solution of nicotine sulfate, the efficiency of the poison being thereby strikingly increased. For example, where these oxidation products have been added, at the rate of one to 200, to nicotine sulfate spraying solutions, a satisfactory kill has been obtained with only one third to one fifth of the nicotine commonly employed when soap is used as a spreader.

The underlying principle is, briefly, the increase of the efficiency, or the activation, of an insecticide by bringing about certain physical changes in the spray mixture.

Silver as Purification Agent

A NEW process for the sterilization of water has been developed in Germany by G. A. Krause, who has already attained success in the field of drying technology. The new procedure is based on the germ-destroying action of minute amounts of very finely divided catalytically active metals. Fine silver proved most effective for this. It was blown upon definite supports so as to produce the largest possible surface. By means of the uniformly blown-out condition, the relation between the volume and the surface which best combined the chemical and catalytic effects was obtained.

On account of this twofold action, the process received the name "Katadyn." In this finely divided state, traces of silver dissolve in the water more rapidly than does ordinary silver. The requisite vessels for this process consist of filtration devices provided with an active silver surface. It was possible by this process to kill 21 million germs per cubic centimeter of water in 48 hours, and when only one million bacteria were contained per cubic centimeter of water the sterilization was effected in only a few hours. Further advantages of the process are that, once it has been set in operation, it requires no more attention and it is independent of temperatures.

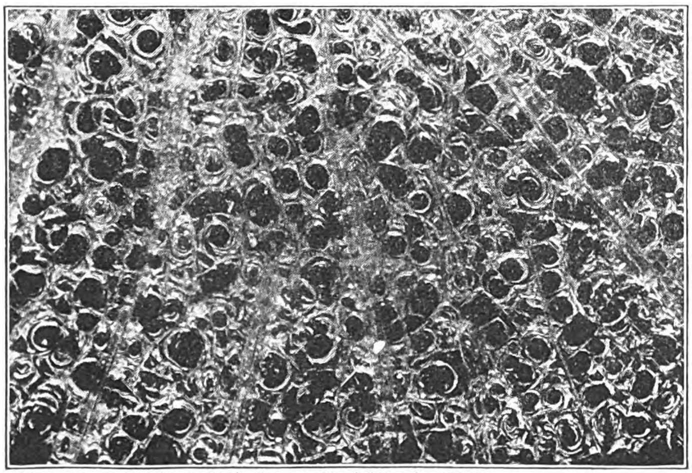
Excess and deficient dosages of silver are impossible, and consequently there is no impairment of the smell and taste of the water which permanently retains its sterility. The process therefore deserves consideration, although it must still be carefully tested for the purification of drinking water on a large scale. The Katadyn process is recommended for the production of mineral water, sterile ice, for hospitals and restaurant kitchens, laundries, for the sterilization of swimming pools, et cetera, in addition to its use in drinking water.

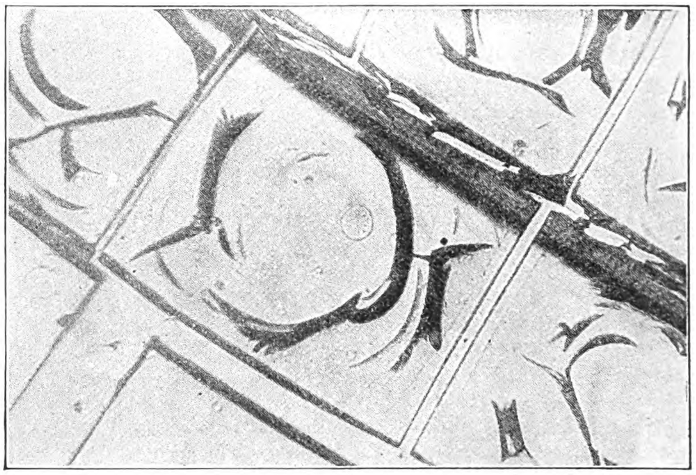
Chlorine Carrier

CONVENIENT application of chlorine for many uses has not always been possible in the past either with bleaching powder or with liquid chlorine itself. Many industrial users of chlorine, especially those requiring relatively small quantities, object to the use of liquid chlorine on account of the difficulties and inconvenience involved in the shipping and handling of the heavy steel containers. The use of bleaching powder has been even less satisfactory in many industrial applications, principally because it is unstable and hence of variable composition and so cannot be depended upon to yield hypochlorite solutions of uniform strength for a given weight of material.

R. E. Gage, writing in *Chemical and Metallurgical Engineering*, announces the commercial development of calcium hypochlorite, a convenient chlorine carrier, free from the objections noted, which holds interesting possibilities for extensive industrial application.

Bleaching powder, although often erroneously referred to as calcium hypochlorite, is actually quite a different chemical compound. True calcium hypochlorite, Ca (OCl^2), has until recent years existed





Photographs courtesy Hercules Powder Company, Chemical Experiment Station

These two photographs show why the family car begins to look shabby after a couple of years' exposure to the elements. At the left is a photomicrograph of a lacquer film, showing how cracks develop in an inferior automobile finish. This picture was taken through a microscope which enlarges the details sixteen times. At the right is a close-up of the same lacquer film, the defects being magnified two hundred times. Chemists are constantly striving to perfect lacquers in order to eliminate this cracking. After such examination of lacquer surfaces, the chemist is emphatic in his advice that it pays to buy the very best quality of lacquer for your car

merely as an ideal symbolized by a formula in the textbooks. It is a highly concentrated chlorine carrier, as the formula indicates. Chemically pure calcium hypochlorite would contain nearly 100 percent "available chlorine" and would thus, pound for pound, be chemically equal to liquid chlorine for all bleaching or oxidizing reactions.

It is impractical to make chemically pure calcium hypochlorite at a reasonable cost. Products containing 80 to 85 percent $Ca(OCl^2)$ have been made in the laboratory on a semi-commercial scale but are too expensive to compete commercially with bleaching powder and liquid chlorine. In the new commercial product it has been decided initially to offer a product containing "available chlorine" in the range of 60 to 65 percent, which under present conditions is the product affording the maximum amount of available chlorine per unit of cost. This is now being marketed under the trade name "H T H," a convenient commercial contraction of the phrase "high-test hypochlorite."

The wide industrial usefulness of a hypochlorite having these properties insures for the new product a substantial and growing market. It will at once find application for industrial operations already established, such as textile bleaching, laundry sterilizing and bleaching, pulp bleaching, dairy disinfecting and bottle sterilizing, and for the chlorination of swimming pools and for isolated water supplies. It may also be predicted with confidence that new industrial and manufacturing uses for such a product are bound to develop.

Bentonite Suitable for Pencil Leads

THE clay for pencil leads must be absolutely free from grit, and, to achieve this, long grinding or a costly refining by endosmotic means is necessary, according to the United States Bureau of Mines, Department of Commerce. Purified bentonite would probably be suitable for the manufacture of pencil leads, and some of the large pencil companies are understood to be using this material already for indelible leads and crayons, thus saving considerably in grinding cost. The use of some other wetting agent would eliminate the excessive drying shrinkage resulting from the use of water with alkali types. The manufacturers of indelible leads, crayons, pastel colors, and the like, where grease or wax is used in the mix, should find bentonite of considerable value as a constituent of their products.

Pure Zinc

AMONG the metals now produced commercially in higher and higher states of purity, zinc has recently held the foreground of interest, it being the latest arrival in the field. The metallurgist's general knowledge that metals of extreme purity have markedly different properties than ordinarily impure commercial products, has stimulated his repeated efforts to produce such metals for commercial purposes.

The Pacific Experiment Station of the United States Bureau of Mines, Department of Commerce, in co-operation with the University of California, at Berkeley, has been studying zinc of exceptional purity, in order to determine whether its heat of oxidation differed materially from that

YOU CAN CHOOSE IF YOU WILL

CHANCE governs the general trend of too many lives. By chance many people live in a certain place, attend a certain school, take the opportune job; they chance upon certain associates, books, and thoughts.

But by courage and determined effort they could choose oftentimes where to live, what to study and, to a large extent, what to accomplish.

Hundreds of thousands of ambitious people are studying at home in their leisure time. Increased earning capacity is the objective that many are attaining. But whether the attainment be greater efficiency in business, or a more interesting social life, or the real joy of developing a more cultured point of view, the studies that lead to these objectives are available, wherever one lives, through Columbia Home Study Courses. The range of subjects is wide.

COLUMBIA UNIVERSITY

Offers Home Study Courses of University Grade in the Following Subjects:

Accounting
Algebra
American Government
American History
American Literature
Applied Grammar
Astronomy
Banking
Biblical Literature
Biology
Botany
Boy Scouting
Business Administration
Business English
Business Law
Business Mathematics
Business Organization
Chemistry
Child Psychology
Classics
Composition
  Dramatic
  English
  Various Languages
  Lyric Poetry
Contemporary Novel
Drafting
Drama
Drawing and Painting
Economics
Economic Geography
English
English Literature
Essay Writing
European History
Fire Insurance
French
Geometry
German
Government
Grammar
Greek
Harmony
High School Courses
History
Investments
Italian
Juvenile Story Writing
Latin
Library Service
Literature
Magazine Article Writing
Marketing
Mathematics
Personnel Administration
Philosophy
Photoplay Composition
Physics
Psychology
Psychology in Business
Public Speaking
Religion
Secretarial Studies
Short Story Writing
Slide Rule
Sociology
Spanish
World Literature

THESE courses have been prepared by our instructors to meet the special requirements of study at home. While all basic material essential to the full understanding of each subject is fully covered, sufficient elasticity is allowed to permit adaptation to the individual needs of the student. Everyone who enrolls for a Columbia course is personally taught by a member of the University teaching staff. Special arrangements can be made for group study.

The University will send on request full information about these home study courses. A coupon is printed below for your convenience. If you care to write a letter briefly outlining your educational interests our instructors may be able to offer helpful suggestions. Mention subjects which are of interest to you, even if they are not listed here, as additions to the courses offered are made from time to time.

HIGH SCHOOL AND COLLEGE PREPARATORY COURSES

COLUMBIA University Home Study Department has prepared courses covering the equivalent of four years of High School study. This complete High School or College Preparatory training is available to those who can not undertake class room work. We shall be glad to send you our special bulletin upon request.

COLUMBIA UNIVERSITY, University Extension—Home Study Department, New York, N. Y. Please send me full information about Columbia University Home Study Courses. I am interested in the following subjects: Sci. Amer. 10-29

. . . .

Name . . . .

Street and Number . . . .

City . . . . State . . . . Occupation . . . .

of less pure metal. Through the courtesy of a large producer of commercial zinc, a sample of metal which had been purified to an almost unbelievable extent was obtained. It showed no detectable impurities when examined with a 16-inch quartz spectrograph. This instrument is capable of detecting less than 1/1000th of 1 percent of impurity, and is in consequence much more sensitive than any but the most refined methods of chemical analysis.

Experiments so far made indicate that zinc of this purity has a heat of oxidation about ½ of 1 percent less than the best previous results, and differs several percent from the ordinarily accepted figures to be found in books of reference. The experiments serve to explain certain discrepancies which have long been suspected to be present in the measurements of this fundamental property of the metal.

Modern Auto Uses Over 100 Chemicals

If a genie out of the Arabian nights were to utter his magic formula over an automobile to reduce it to its original state, the result would be first a pile of assorted parts and finally a mass of ore and sundry chemical compounds, says L. B. Case of the General Motors Corporation in *Chemical Markets*. "A wide variety of material is used in producing automobiles and in the list are more than 100 of the substances commonly included in chemical price lists. Many of these substances become a part of the machines and are delivered to the customers. Others are used in the processes of fabrication, either by the automobile manufacturers or by concerns supplying semi-finished materials. In this latter class are included fuels, refractories, lubricants, lacquer thinners, tool steels, carburizing compounds, and plater's supplies."

Although primarily mechanical in its construction, the automobile of today, with its refinements, is to a marked degree a product dependent upon chemicals and chemical research. Some of the items in the appended list are used in relatively small quantities, but nevertheless are important and, in several instances, are essential factors in producing the modern automobile.

CHEMICALS USED IN AUTOMOBILES

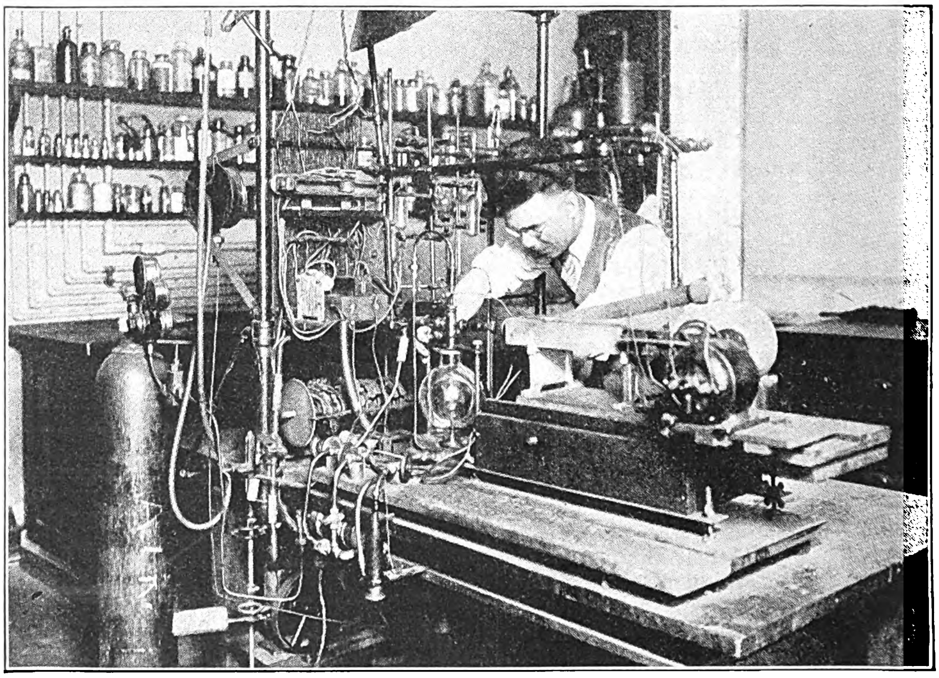
Acetic acid
Amyl alcohol
Aluminum
Ammonium chloride
Amyl acetate
Antimony
Asbestine
Barium carbonate
Battery acid
Blanc fixe
Bauxite
Bone black
Borax
Boric acid
Butyl acetate
Butyl alcohol
Calcium carbide
Calcium carbonate
Calcium chloride
Carbon black
Carbon dioxide
Carbon tetrachloride
Casein
Castor oil
Celluloid
Cellosolve
Cellosolve acetate
Charcoal
Chinawood oil
Chromic acid
China Clay
Chlorine
Chrome green
Chrome yellow
Coconut oil
Copper
Copper cyanide
Corn oil
Cottonseed oil
Degras
Dextrin
Dibutylphthlate
Diphenylguanidine
Ethyl acetate
Ethyl alcohol
Ethyl lactate
Ethylene glycol
Fluorspar
Formaldehyde
Fusel oil
Glue
Glycerine
Graphite
Gilsonite
Hydrochloric acid
Hydrofluoric acid
Lard oil
Lead oxide
Lime
Linseed oil
Lithopone
Naphtha
Nickel
Nickel sulfate
Niter cake
Nitric acid
Nitrocellulose
Paraffin
Petrolatum
Phenol
Phosphoric acid
Plaster of Paris
Potassium chloride
Prussian blue
Pumice stone
Rosin
Rotten stone
Saltpeter
Shellac
Silica
Soapstone
Soda ash
Soda caustic
Sodium chloride
Sodium cyanide
Sodium nitrate
Sodium nitrite
Sodium phcsphate
Sodium silicate
Starch
Sulfur
Sulfuric acid
Tallow
Titanium pigment
Tripoli
Turpentine
Whiting
Xylene
Zinc
Zinc chloride
Zinc cyanide
Zinc oxide

Soap Dust Found to be Highly Explosive

Smooth, flaky soap powder, which plays so great a part in the work of keeping the world clean, is, when suspended in air, a highly explosive substance, capable under certain conditions of causing a serious explosion, states the Department of Commerce. Tests conducted at the Pittsburgh, Pennsylvania, Experiment Station of the United States Bureau of Mines, with soap dust in suspension produced even more violent explosions that were attained with dry coal dust, which, as is generally known, has been responsible for many violent explosions in coal mines. The explosive hazard of soap dust is, of course, a serious factor only in the case of suspension of considerable amounts in air, such as might occur in the process of manufacture. Presence of this widely used cleansing medium in the family washing machine carries no hazard whatever.

It is only recently that pure powdered soap has been manufactured on a large scale. The familiar "soap powder" in the past was usually a mixture of soap with a relatively large quantity of sodium carbonate. Often it contained large amounts of moisture and abrasive material. Even a highly combustible dust when mixed with large quantities of inert dust will not form explosive mixtures with air. Pure powdered soap, however, presents a different aspect. Pure soap is formed by combination of alkali (incombustible material) with fatty acid (combustible material). Toilet soap may also contain a certain amount of glycerin and essential oils which, being combustible, influence the explosibility of the dust. Sodium compounds, however, are known to have a "cooling" effect on the flames of explosives. Whether the pure soap, sodium stearate for example, would form explosive suspensions with air might then be a matter for actual experiment to determine.

Although the relatively large size of the particles of soap would perhaps indicate it to be not highly explosive, the explosibility tests showed that in every case more violent explosions were obtained with the soap dust than with the coal dust. Thus,



Apparatus used to determine that soap dust is explosive

more flame and heat appeared and much more pressure was produced in the explosion flask with soap dust than with an equal weight of coal dust. Moreover, not so high a weight-concentration of soap dust is necessary to form an explosive mixture with air. Evidently suspensions of this soap dust become dangerous when the concentration is greater than about 0.1 gram of dust per liter. With finer dusts or more intense sources of ignition the explosibility hazards will be greater.

Nickel Welded With Flux in Flame

DESPITE the common textbook assertions that nickel is unweldable by fusion methods, N. B. Pilling and T. E. Kihlgren, of the International Nickel Company, in a paper before the American Electrochemical Society, showed that both nickel and Monel metal are excellently adapted for fabrication by fusion welding. The production of welds which are strong, sound, and ductile requires adherence to suitable methods of welding rather than to the exercise of unusual manual skill. Of the arc methods, the carbon arc is preferred because it yields a weld metal superior in strength and soundness to that laid down by the metallic arc. Welds of excellent quality can be produced by the acetylene flame, provided the fluxing conditions are controlled.

The application of a suitable flux for this purpose is accomplished in a most ingenious manner, for which the welder may thank chemistry. The flame itself is given a mild but controlled fluxing action, by the introduction of ethyl borate (a gas) into the acetylene supply.

Industry Developed to Use Waste Straw

WESTERN Canada has found a new and profitable use for straw. According to the *Paper Trade Journal*, a company has been incorporated in Regina for the manufacture of strawboard to replace ordinary lumber in the construction of buildings. One such machine has recently been placed in operation on the farm of T. A. McCusker, one mile north of Regina. Patent rights for Canada have been acquired. The machine, it is stated, compresses the straw under a pressure of 100 pounds to the square inch, the product being laced with wire and turned out in boards 14 feet long, five feet wide, and two inches thick.

The matter of the economic disposition of cereal straws of western Canada, enormous supplies of which are available, has long occupied the attention of the government, the Canadian Pacific Railway, the National Research Council, industrial development boards, Boards of Trade, and other public bodies.

Allowing for the great increase in field crops in western Canada each year, the volume of this material annually destroyed in the western provinces cannot be much short of ten million tons. It is now hoped to put this waste product to profitable use in the form of pulp and paper, building blocks, tile, et cetera.

Great interest has also been manifested in the utilization of straw in the manufacture of newsprint from straw and the Canadian Pacific Railway has sponsored certain experimental methods for the utilization of flax straw in the manufacture of high grade papers.

Do you think it's

Too Good to be True!

Every plant superintendent has dreamed of the time when his plant would be trouble-proof

YES, your plant can be made trouble-proof as far as the flexible couplings are concerned. Flexible coupling troubles can actually be made a thing of the past.

What is it that causes coupling shutdowns in your plant? Almost invariably replacing broken springs, rings, bushings, pins, discs or grids—flexible materials that fatigued and failed. Eliminate the flexible materials and the problem is solved!

How? Fast answered that question. As the diagram below shows, two spur gears are in complete and continuous mesh with the internal gears of a floating sleeve. The sleeve takes a neutral position, the error in misalignment is taken up between the lubricated faces of the gear teeth, and all necessity for flexible materials is eliminated.

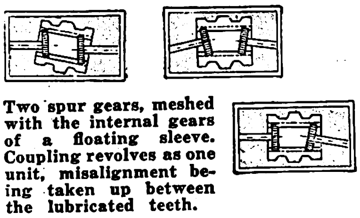
It has been demonstrated mathematically, experimentally and in actual operation of tens of thousands of couplings that there is no metal-to-metal contact beween the gear teeth. The oil in the sleeve, under the centrifugal pressure due to revolving of the shafts, is thrown between the faces of the gear teeth, providing an actual oil cushion that carries the load.

If you are purchasing new equipment—or if you have a danger drive with which you have recurring coupling troubles—let us know. Tell us the kind of equipment, the kind of service, the H. P., the R. P. M., and the shaft diameters, and we will submit prices at once. You will be surprised to find (in most cases) that the cost of the Fast's Coupling is little if any more than the old style. But the difference in performance is so marked that Fast's Couplings are always cheapest in the end.

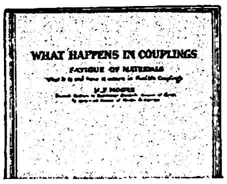
Also do not fail to send the coupon for the extremely illuminating book by Prof. Moore on "What Happens in Couplings." It's valuable, but it's free. Send for it.

FAST'S
Self-Aligning
COUPLING

The coupling without flexible bushings, pins, springs, discs, grids or any other flexible materials.



Two spur gears, meshed with the internal gears of a floating sleeve. Coupling revolves as one unit, misalignment being taken up between the lubricated teeth.



Get this authoritative book, which clearly shows how flexible materials can be avoided in coupling design.

Sign and Mail this Coupon for Free Book.

Read Prof. Moore's authoritative discussion of the failure of flexible materials

THE BARTLETT HAYWARD CO.
204 SCOTT STREET . . . BALTIMORE, MD.

*Company*________ *Individual*________

*Address*________ *City*________ *State*________

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

AVIATION, a special edition of the *Black Hills Engineer*, is an interesting little book presenting articles by authorities in various fields of commercial aviation, including photography, meteorology, electricity, mining, forestry, civil engineering, medicine, and general topics. *The Black Hills Engineer, South Dakota School of Mines, Rapid City, South Dakota—25 cents.*

WEATHER AND THE AIRPLANE, by Edward H. Bowie, meteorologist of the United States Weather Bureau at San Francisco, is a study of the model weather reporting service on the airway between Los Angeles and San Francisco. The study is well illustrated. *Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc., 598 Madison Avenue, New York City—Gratis.*

Electricity

PROTECTION AGAINST LIGHTNING, Bureau of Standards Miscellaneous Publication No. 92, discloses valuable facts about the importance and location of lightning arresters, installations of electrical equipment with due provisions for safety, and contains a summary of the present knowledge about lightning. *United States Government Printing Office, Washington, D. C.—25 cents.*

THE TELEPHONE SWITCHBOARD; FIFTY YEARS OF HISTORY, by Frank B. Jewett, is a historical sketch of the development of the telephone switchboard, showing the various types of equipment used during the past 50 years. *Bell Telephone Laboratories, Incorporated, 463 West Street, New York City—Gratis.*

INSPECTION AND TESTING OF MINE-TYPE ELECTRICAL EQUIPMENT FOR PERMISSIBILITY, Bulletin 305 of the Bureau of Mines, Department of Commerce, discusses the theory upon which are based tests of equipment in explosive atmospheres. *United States Government Printing Office, Washington, D. C.—10 Cents.*

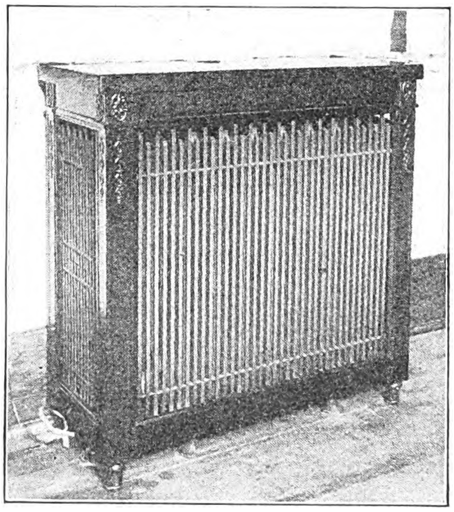
Heating and Ventilating

MAN-MADE BREEZES is a small, fully illustrated booklet tracing the development of circulated air equipment. The equipment described in the latter pages of the booklet is for use in homes and apartments, as well as business buildings. *American Coolair Corporation, Jacksonville, Florida—Gratis.*

OIL HEAT AND THE BUSINESS OF LIVING presents the case in favor of oil burners for domestic heating purposes. *The Oil Heating Institute, 342 Madison Avenue, New York City—Gratis.*

HEAT TRANSFER BY RADIATION includes a synopsis of the present knowledge on radiation of heat. A bibliography, with brief reviews, is also furnished. *Committee on Heat Transmission, National Research Council, 40 West 40th Street, New York.—Gratis.*

INVESTIGATION OF HEATING ROOMS WITH DIRECT STEAM RADIATORS EQUIPPED WITH ENCLOSURES AND SHIELDS, Bulletin No. 192, is the report of an investigation which led to a determination of the best types of enclosures and shields for steam radiators. The booklet has about 40 illustrations, showing various types of enclosures, and diagrams portraying the air circulation in test rooms heated with covered radiators. *Engineering Experiment Station, University of Illinois, Urbana, Illinois—40 cents.*



The radiator enclosure illustrated is the type said to give the greatest comfort, with economy of steam

Investments

BIGGER INVESTMENT RETURNS AND BIGGER BUSINESS PROFITS are small booklets describing the Babson service. *Babson's Statistical Organization, Inc., Wellesley Hills, Mass.—Gratis.*

LOOKING AHEAD FINANCIALLY, is intended to help investors who desire to acquire with their current income such property and securities as will enable them to accumulate the source of a permanent income. *Halsey, Stuart and Company, 201 South La Salle Street, Chicago.—Gratis.*

PROTECTION AND A GOOD INCOME is a booklet showing the investment advantages of a sound public utility preferred stock with descriptions and photographs of the various Doherty properties. *Henry L. Doherty and Company, 60 Wall Street, New York.—Gratis.*

CHAIN STORE SECURITIES is a booklet in which are listed many securities of this type. *F. A. Brewer and Company, 42 Broadway, New York.—Gratis.*

HOW TO INVEST MONEY describes various types of securities of interest to investors. *S. W. Straus and Company, 565 Fifth Avenue, New York.—Gratis.*

Refrigeration

SEVENTY-FIVE YEARS OF PROGRESS gives a summarized review of the refrigerating and ice-making industry as a whole, and of the Frick Company in particular. The booklet is well arranged and handsomely illustrated. *Frick Company, Inc., Waynesboro, Pa.—Gratis.*

REFRIGERATION is a comprehensive treatise on the history of mechanical refrigeration leading up to the modern machines for industrial and domestic use. The paper is well illustrated with views of the refrigerators now made by the company. *General Electric Company, Schenectady, New York—Gratis.*

Safety

HYDRO-EXTRACTORS, THEIR SAFE CONSTRUCTION AND EQUIPMENT, is one of the industrial publications issued by the International Labor Office of the League of Nations. The monograph is an engineering study in non-technical language, planned to protect workers operating centrifugal industrial machines in laundries, beet sugar plants, and chemical works. *World Peace Foundation, 40 Mount Vernon Street, Boston.—One dollar.*

THE INDUSTRIAL MEDICINE CHEST is an illustrated booklet describing the materials and equipment needed by the industrial surgeon dealing with occupational injuries. *Abbott Laboratories, North Chicago, Illinois—Gratis.*

THE LIFELINE OF THE HIGHWAY, CATALOG NO. 169, is chiefly a pictorial description of the advantages of flexible woven-wire highway guard over wooden guard rails at danger points on public highways. *Page Steel and Wire Company, Bridgeport, Connecticut.—Gratis.*

Miscellaneous

YOU CAN MAKE IT describes practical uses for secondhand boxes and odd pieces of lumber. The booklet is published by the National Committee on Wood Utilization of the Department of Commerce to teach boys the proper use of wood and to induce them to make their own toys and equipment. The booklet will also interest manual-training teachers and vocational directors. *United States Government Printing Office, Washington, D. C.— 10 cents.*

THE MEASUREMENT OF THE DISCHARGE OF THE NILE THROUGH THE SLUICES OF THE ASWAN DAM, by H. E. Hurst and D. A. F. Watt, is a contribution from the Physical Department of the Ministry of Public Works, marking the conclusion of a great Egyptian undertaking which has extended over more than 20 years. The developments arising out of this work are considered of importance outside Egypt on account of their general applicability. *Publications Office, Government Press, Bulaq, Cairo, Egypt.—10 piasters; suggest sending 75 cents.*

AMERICA'S FOURTH MARKET tells the story of the growth of Detroit and the *Detroit Free Press.* The growth of the area adjacent to the city is reflected in the spectacular development of a great industrial center, and provides the background for the story of a newspaper which has served the community for almost a hundred years. The booklet is addressed to national advertisers in particular. *Detroit Free Press, Detroit, Michigan.—Gratis.*

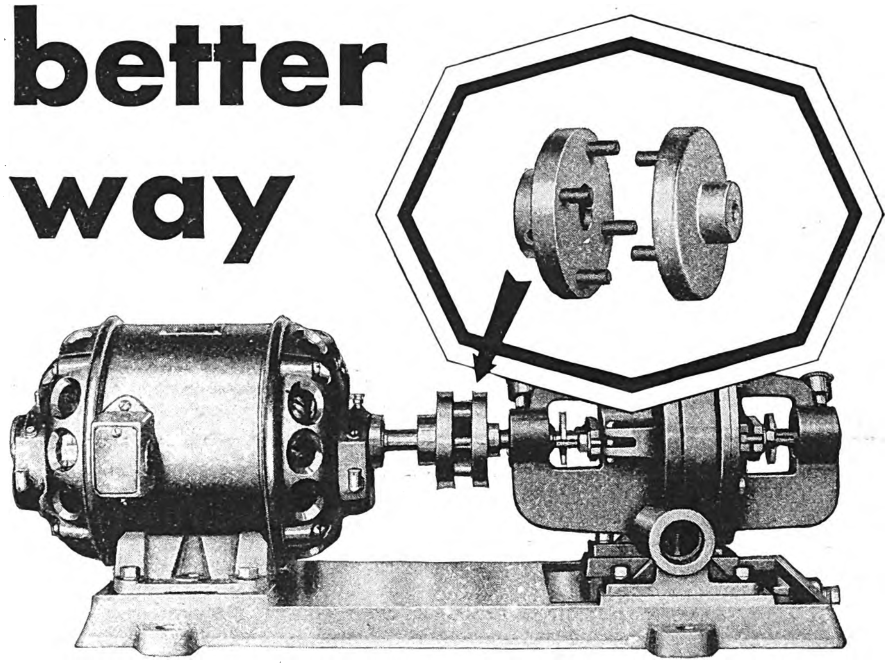
HOW TO JUDGE A USED CAR tells the prospective purchaser a few of the common mistakes to avoid when purchasing a used car, with constructive pointers on the essentials to be investigated. About half of the book is taken up with condensed data about the mileage records held by products of the company. *Studebaker Corporation, Department 256, South Bend, Indiana.—Gratis.*

FORESTRY ALMANAC, a 390-page book prepared by the American Tree Association with the co-operation of federal and state forestry officials and others, shows the progress made in combating national deforestation. A chapter is included which summarizes forestry activities in foreign countries. The book has a good bibliography and index. *American Tree Association, 1214-16th Street, N. W., Washington, D. C.—One dollar.*

JOURNALISM, YOUR FUTURE, AND YOU shows the value of newspaper training as given in modern journalism courses based on the copy-desk method of handling news. *Newspaper Institute of America, Inc., 1776 Broadway, New York City—Gratis.*

THE MANUFACTURE OF NICKEL STEEL PLATE is a reprint dealing with the manufacture, rolling, and inspection of steels containing between 2 and 3 percent of nickel, and which are used for boiler construction. The study is well illustrated. *International Nickel Company, Inc., 67 Wall Street, New York City—Gratis.*

THE RAT, ARGUMENTS FOR ITS ELIMINATION AND METHODS FOR ITS DESTRUCTION, has been issued as Public Health Bulletin No. 180. The well-known reasons for destroying the pest are reviewed, and methods are prescribed for trapping and poisoning various types of rats. Fumigants are also discussed, and instructions given for making a building rat-proof. *United States Government Printing Office, Washington, D. C.—Five cents.*



a Simpler better way

. . *to make a coupling!*

THE Westco-Chippewa Pump Co. found it, when they turned to die casting as a means of improving the design and performance of the couplings used on small pumps and water systems.

These couplings now consist of two simple, zinc alloy die castings, circular flanges about 3/8" thick. In each flange are four steel driving pins, accurately cast into place when the casting is made. A shoulder on each pin anchors it permanently into position as the zinc alloy solidifies. The only machining required is the reaming of the shaft hole. The die used is so designed that various sized shaft-holes can be cast, either with or without the key-way.

The lighter weight of die cast couplings has greatly reduced vibration and noise. Casting the pins into place as an integral part of the flange has eliminated several machine and assembling operations.

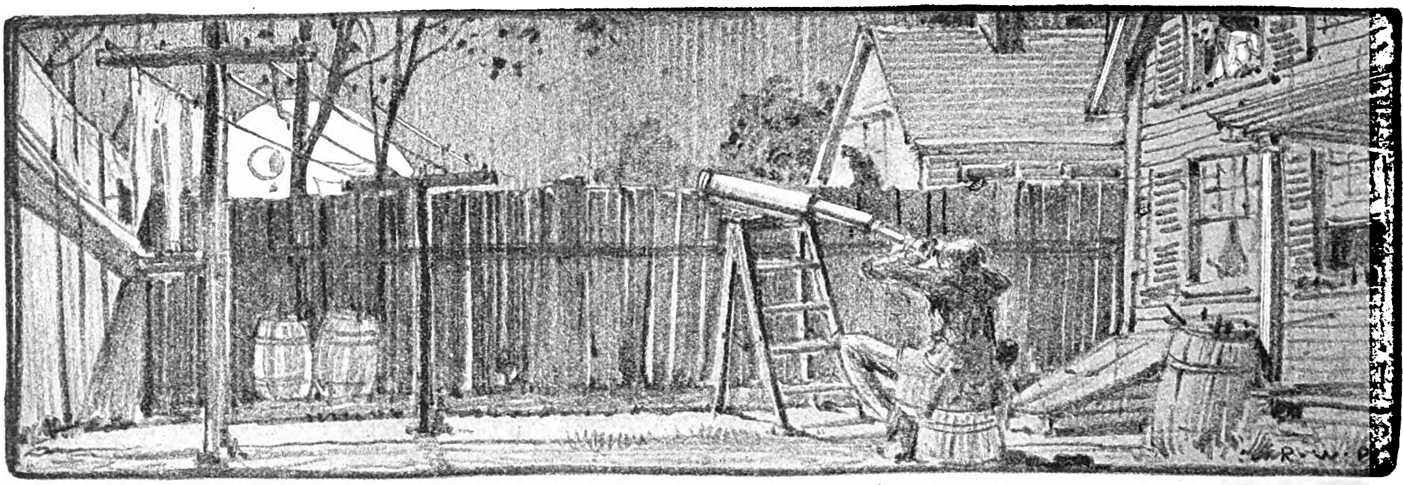
Perhaps die casting parts of your product would result in similar improvements. Why not let us help you find out?

This non-technical, illustrated booklet may suggest an easier, better way to make parts of your product. Send for your copy today.

MILWAUKEE DIE CASTING COMPANY
287 FOURTH STREET MILWAUKEE, WIS.

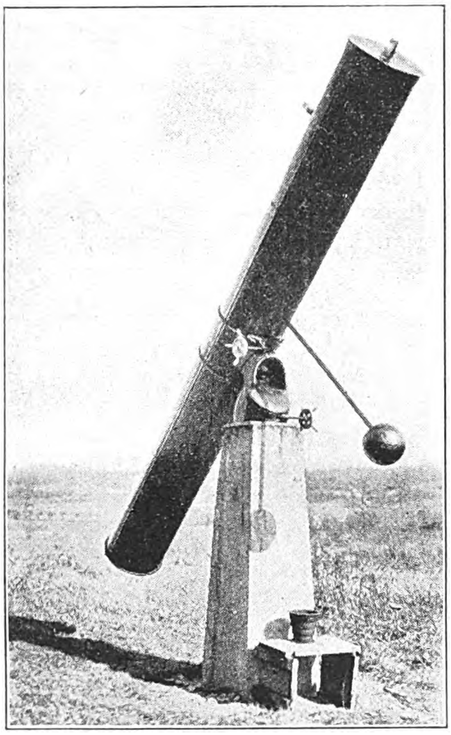
MILWAUKEE
DIE CASTINGS AND BEARINGS

YOUR PRODUCT and DIE CASTING



The Amateur Astronomer

IT has been suggested that the readers are getting tired of seeing descriptions of telescopes made by amateurs, but we are not at all certain that this is the case. Perhaps, however, we can make a compromise, publishing every description received, but shortening those that are long.



Mr. Scott's Springfield type telescope, mounted as a Newtonian

This time we shall describe three telescopes. The first is by H. B. Scott, National Cash Register Co., Dayton, Ohio. His own description is brief in the extreme. The mounting is of the well known "Springfield" type, invented by Russell W. Porter, co-author of the SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making." The castings for these mountings are available in various metals and are made up to order from a standard set of patterns at Springfield, Vermont.

Mr. Scott states that his mirror is a 12-inch, with focal length of 10 feet. Evidently his focal length is so great that he can not use the usual diagonal mirror which, with a second diagonal, confers upon this type of mounting its most valuable quality, the ability to see in any direction through a stationary, fixed eyepiece without craning the neck.

H. L. ROGERS, a real estate broker, 10 Adelaide Street East, Toronto, has made a whole family of telescopes (see A.T.M., page 220) and now sends in a picture of his latest "edition," a 12-inch reflector. He writes:

"The focus of the 12-inch mirror, which is 1½-inch thick, is eight feet. The tube, which is revolvable, is eight feet long; of 18-gage galvanized iron, riveted and finished in gray Duco. The mirror rests on three adjustable three-inch disks. The drums of a Ford transmission will be in evidence if the photograph is examined closely. There is a close fitting cover for the mirror cell, for the diagonal, and for the end of the tube.

"The finder is mounted fairly well away from the tube so that either eye may be used. Adjustment of the finder is by having slightly slotted holes in the tube, so that the supports may be spread for vertical adjustment and moved sideways for lateral adjustment. This works well, without the necessity of the usual ring and screw arrangement.

"After setting the whole thing up, I found that my arm was about three feet too short to reach the slow motion in right ascension. By means of an old golf stick and a home made spring of steel wire, which just fitted over the projecting end of the slow-motion spindle sufficiently tight to take hold, and with the end of the spring turned up at right angles like a finger to engage in the spokes of the little hand wheel, I was able to rig up a very effective means of working the slow motion while standing on a ladder at the eyepiece. This will work at 90 degrees where a universal joint would not.

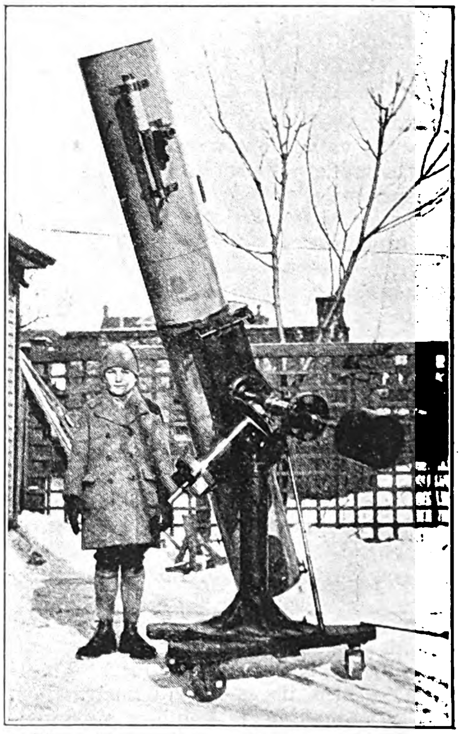
"The clamps in declination and R.A. are metal-to-metal friction bands turned in the lathe and are adjusted by a small screw, allowing the telescope to move easily without binding and yet they hold it in place when necessary.

"I enclose a local newspaper's idea of a description of a telescope; life has scarcely been worth living since this appeared. However, I am bearing up bravely."

FROM time to time we have received certain premonitions that Mrs. Margaret L. Wiesenberg, of Christian Witness to Israel, Inc., 521 West 179th Street, New York, was making a telescope. And now we can prove it: Mrs. Wiesenberg, at our special request, sends us a photograph of telescope and maker. We can bear witness that she has a good grasp of the work, both practical and theoretical. The parts of the telescope we have seen look as shiny as a new dollar, and the whole job looks fit, and is fit, to use in regular astronomical work.

Latest advice is that another woman, a missionary stationed away out in Sumatra, is starting a telescope. Yet we occasionally hear from some *man* who fears he can not do the work.

IN the last number we spoke of popularizing seismology. We have received



Mr. Rogers' ten-inch reflector. Study the detail of the mounting

one remarkable suggestion—from an amateur telescope maker, at that: "By attaching a seismograph to a telescope," he says, "it might be possible to record 'quakes (they wouldn't be called earthquakes, of course) on Mars and the other planets." What an idea! Thus is Yankee inventiveness vindicated. We are turning this man over to Mr. Edison for observation.

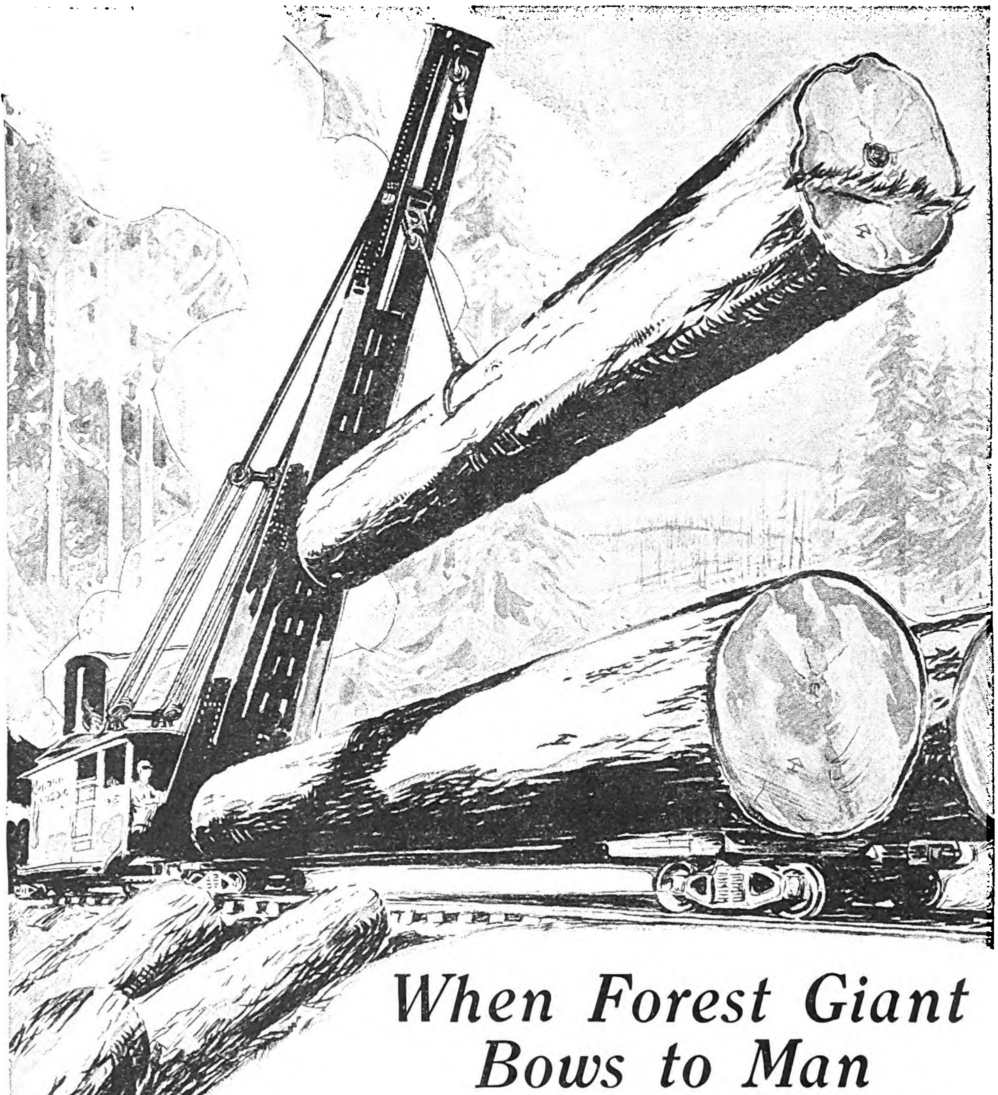
THE following is quoted from the Publications of the Astronomical Society of the Pacific:

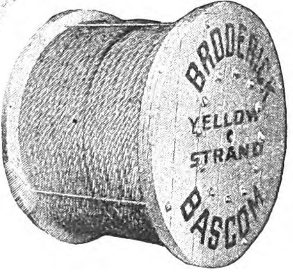
"The question whether Fraunhofer's lines reveal the presence of gold in the sun was being investigated. Kirchhoff's banker remarked on this occasion, 'What do I care for gold in the sun if I cannot fetch it down here?' Shortly afterwards Kirchhoff received from England a medal for his discovery and its value in gold. While handing it over to his banker he observed, 'Look here, I have succeeded at last in fetching some gold from the sun.'"

Mrs. Wiesenberg with her Springfield type telescope on a tripod

THE Fourth Annual "Convention" (informal get-together) of the Telescope Nuts of America was held, this year, on August 10, at the usual place, *Stellafane*, near the village of Springfield, Vermont. The attendance was 121, twice that of the previous year. The first of these get-togethers, held four years ago, brought out about 20 amateur telescope makers, but the number has doubled each year. Project the same rate of growth into the future and it will require only a little calculation to prove that everybody on earth is certain soon to become a telescope maker.

People come to *Stellafane* from the entire east for the opportunity to meet other addicts of this form of sport. These gatherings, the next of which, it is hoped, you are already planning to attend in 1930, are held at the clubhouse observatory of the Telescope Makers of Springfield on top of Mount Porter, one of the offshoots of the famous Green Mountains of Vermont, and "far from the madding crowd." People who want the comforts of home stay at the hotel in the village, three miles distant; those who like to camp bring tents and pitch them near *Stellafane;* others to whom physical comfort has no meaning do not "put up" at all, they sit up





When Forest Giant Bows to Man

After a crashing fall, and the mammoth trunk has been cut into mammoth logs, then—

The sturdiest of wire ropes steps in for duty—the heaviest kind of duty; for these great logs must be dragged in and loaded onto cars, expeditiously and with safety to logging crews.

Out where the giant Redwood, Spruce and Fir are "logged," one is impressed by the amount of wire rope with one strand painted yellow, the distinguishing mark of Yellow Strand Wire Rope.

This powerful rope is the great pride—the "pet"—of a company that has made nothing but wire rope for over half a century. Its wires are drawn abroad, in the celebrated Sheffield Steel district, from equally celebrated Swedish stock.

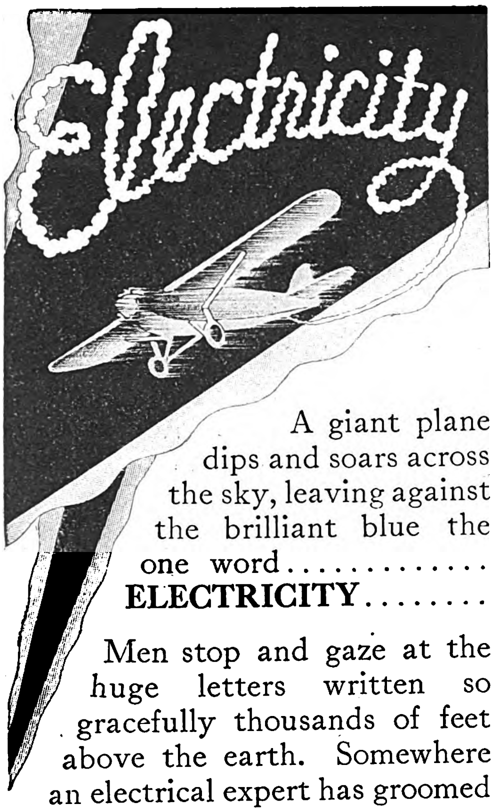
For greatest economy under severe conditions, always specify Yellow Strand.

B. & B. Aerial Wire Rope Tramways have features that are well worth investigating.

BRODERICK & BASCOM ROPE CO.
St. Louis, Mo.
Eastern Office and Warehouse : 68 Washington St., New York
Western Offices: Seattle and Portland, Ore.
Factories: St. Louis and Seattle

Yellow Strand
WIRE ROPE

N807BS3


Electricity

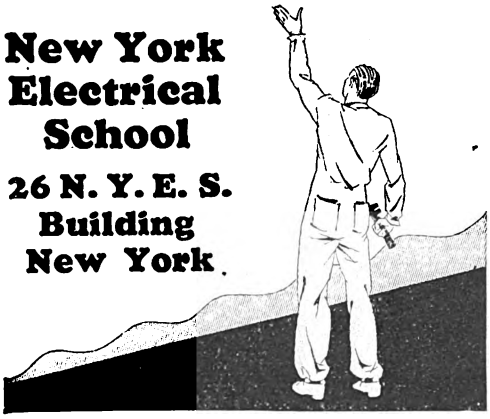
A giant plane dips and soars across the sky, leaving against the brilliant blue the one word.............. ELECTRICITY........

Men stop and gaze at the huge letters written so gracefully thousands of feet above the earth. Somewhere an electrical expert has groomed the giant plane for its flawless flight . . . every wire tested . . . every electrical device in perfect running order.

Today industry is as dependent upon the expert electrician as the powerful plane tracing the magic name over countless cities and towns. To him come the profits of industry and commerce. You, too, can be an electrical expert.

Write today for the 48-page booklet. Use the coupon below.

New York Electrical School
26 N. Y. E. S. Building
New York



MAIL TODAY

THE NEW YORK ELECTRICAL SCHOOL
26 N. Y. E. S. Building, New York.

Please send me FREE your 48-page booklet. It is understood that this request puts me under no obligation

Name..

Address..

all night to look at the stars and talk with other amateur astronomers, catching up on sleep later in their lives. And, apparently, a good time is had by all.

No fixed program of papers or other bothersome formality is allowed to spoil these meetings, the only fixed event being the "big feed," sometimes spoken of as dinner. This year the usual bean-hole beans (genuine bean hole, too) were supplemented by some 19 marine acres of baked clams.

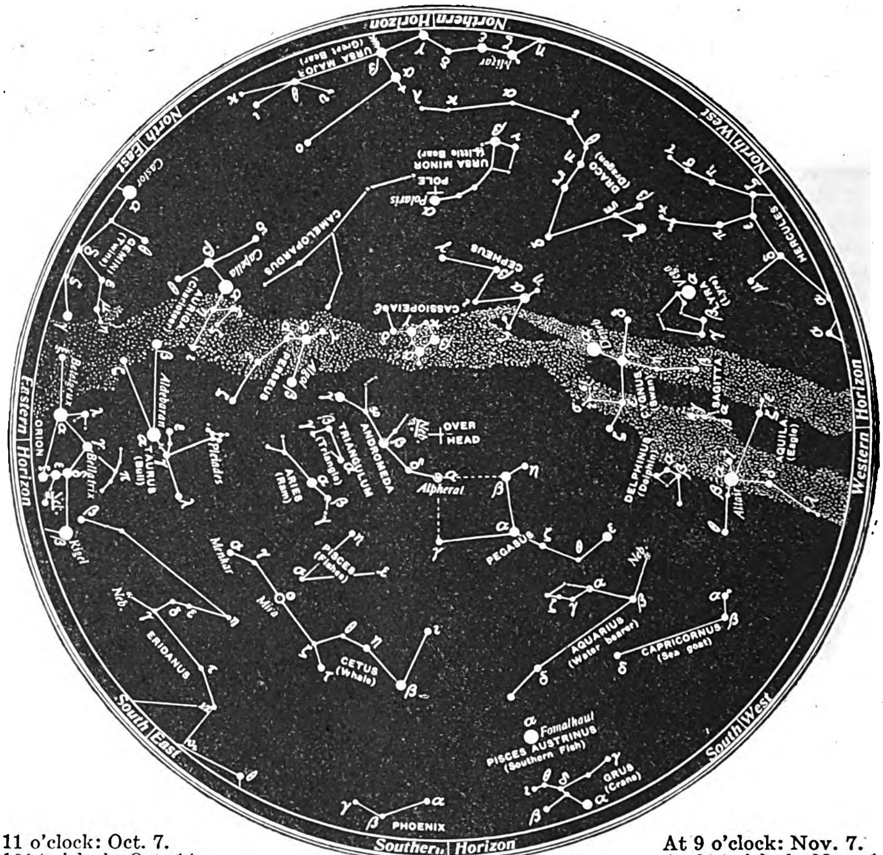
Several enthusiasts brought their telescopes for all to see and admire, while still more brought mirrors to be tested. These ranged from six inches in diameter up to twelve. To test the telescopes on the actual stars proved impossible this year because, for the first time since these conventions were begun, it rained. However, a better test of a mirror can be had on an artificial star than an actual one, and people attend to "talk shop," not to see stars.

Although it is nearly a year in advance, all you who are making or hope to make telescopes should pin up in the background of your mind a memorandum to attend the annual get-together to be held some time next summer. If the present rate of increase is maintained it may then be necessary to provide a circus tent for visitors' quarters. Certain it is that the amateur telescope hobby is waxing, not waning.

The response to our "feeler" on the study of microscopic pond life justifies publication of further articles. This, we hope, will be done next spring, as the subject is not a winter one.—*A.G.I., Tel. Ed.*

The Heavens in October

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
URSA MAJOR (Great Bear)
Mizar
URSA MINOR (Little Bear)
POLE
Polaris
DRACO (Dragon)
HERCULES
CAMELOPARDUS
CEPHEUS
CASSIOPEIA
Castor
GEMINI (Twins)
Capella
AURIGA (Charioteer)
LYRA (Lyre)
Vega
Deneb
CYGNUS (Swan)
SAGITTA
AQUILA (Eagle)
Altair
DELPHINUS (Dolphin)
PERSEUS
Algol
Betelgeux
ORION
Bellatrix
Rigel
Aldebaran
TAURUS (Bull)
Pleiades
ARIES (Ram)
TRIANGULUM (Triangle)
ANDROMEDA
Neb.
OVER HEAD
Alpheratz
PEGASUS
PISCES (Fishes)
Menkar
Mira
CETUS (Whale)
ERIDANUS
AQUARIUS (Water bearer)
CAPRICORNUS (Sea goat)
Fomalhaut
PISCES AUSTRINUS (Southern Fish)
GRUS (Crane)
PHOENIX

At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.
At 9½ o'clock: October 30.
At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.
The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

MERCURY is in conjunction with the sun on the 8th. He rushes rapidly to elongation on the 23rd, but since he is close to perihelion, and only 18 degrees from the sun, he will not be easy to see. During the last week of the month he rises about 5 A.M. and may be caught before dawn. Venus is a morning star, rising about 3:30 when the month begins, but not until 4:30 at its close. Mars, after a long period of visibility as an evening star, is passing out of sight and can barely be glimpsed in the twilight. Jupiter is in Taurus and rises a little after 8 P.M. in the middle of the month. Saturn is an evening star in Ophiuchus, setting about 9 P.M. in the middle of the month. Uranus is in opposition on the 3rd, being found in Pisces in 0h 35m 41s R.A. and 3°3′ north declination. An equatorial telescope or a good star map will be necessary to identify the planet as there are no convenient guide stars near by. Neptune is a morning star rising about 2 A.M. Like Uranus, Neptune is invisible to the naked eye.

The moon is new at 5 P.M. on the 2nd; in her first quarter at 1 P.M. on the 10th; full at 7 A.M. on the 18th; and in her last quarter at 3 A.M. on the 25th. She is nearest the earth on the 22nd and remotest on the 10th. As she sweeps around her track she passes Mercury on the 3rd, Mars on the 4th, Saturn on the 8th, Uranus on the 17th, Jupiter on the 21st, Neptune on the 27th, Venus on the 30th, and Mercury again later in the same day.

The Scientific American Digest

(*Continued from page* 344)

In appearance the apparatus resembles only remotely the X-ray apparatus now in use. The Coolidge X-ray tube, the heart of the apparatus in which are generated the invisible rays of light which penetrate the body and make possible the photographing of bones and organs, is concealed in an aluminum container filled with oil. It more nearly resembles the camera of the photographer than the complicated X-ray apparatus one now sees in hospitals and offices of physicians. An adjustable slit diaphragm permits the passage of the invisible rays by which "radiographs" are made.

This new shock-proof apparatus is the result of several years of development and engineering in the research laboratory of the Victor Corporation, under the direction of Vice President J. B. Wantz.

"While X-ray apparatus, now so important in diagnostic work, such as locating foreign particles in the body and in studying fractured bones, has been reasonably safe," Mr. Wantz declared, "the newly developed apparatus is 100 percent electrically safe.

"The complete insulation makes the new machine especially valuable when X raying highly nervous patients and children. The absence of all overhead or exposed wiring carrying high voltages also makes possible the obtaining of X-ray photographs at angles hitherto impossible."

Virtually any part of the patient's body may be X rayed from any angle without moving the patient. Manipulation of the device to the patient's position replaces the shifting of the patient's position to suit the needs of the device, Mr. Wantz pointed out. Such manipulation is an invaluable aid when severely injured patients are being X rayed.

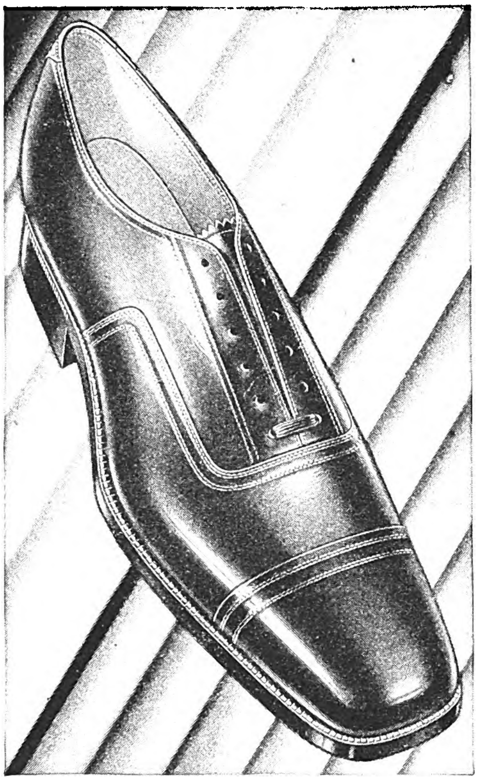
The movable part of the apparatus weighs in the neighborhood of 500 pounds, yet it is so delicately balanced that it can be moved literally with the little finger. This feature, combined with elimination of danger from contact with exposed wiring and possibility of shock to operator or patient, makes it possible to obtain radiographs as rapidly as though a photographer were employing an ordinary high-speed camera.

By insulating the actual X-ray apparatus in oil, another scientific obstacle in roentgenology has been overcome. At high altitudes, such as occur in the Rocky Mountain regions or in South America, X-ray apparatus of twice the power usually employed at sea level is necessary because the higher altitudes decrease the capacity of the machine. With the apparatus immersed in oil the new machine operates uniformly at all altitudes and is not affected by extremes in humidity.

Ghosts of Words "Walk" on Old Manuscripts

ULTRA-VIOLET rays have achieved a new miracle. Ghosts of words erased many centuries ago from old manuscript pages are "walking" in luminous garb, summoned back from oblivion through the "magic" of a Viennese scientist, Professor G. R. Kogel.

It is well known that the old manuscript writers often erased the hand lettering on parchments and economically used the



For the Man who Cares

LONG after you would expect any shoe to have lost its shape and its smartness, THE FLORSHEIM SHOE is still giving service . . . It is still shapely . . . still handsome . . . still a pleasure and a credit to its wearer!

THE PICK . . . *Style* M-362

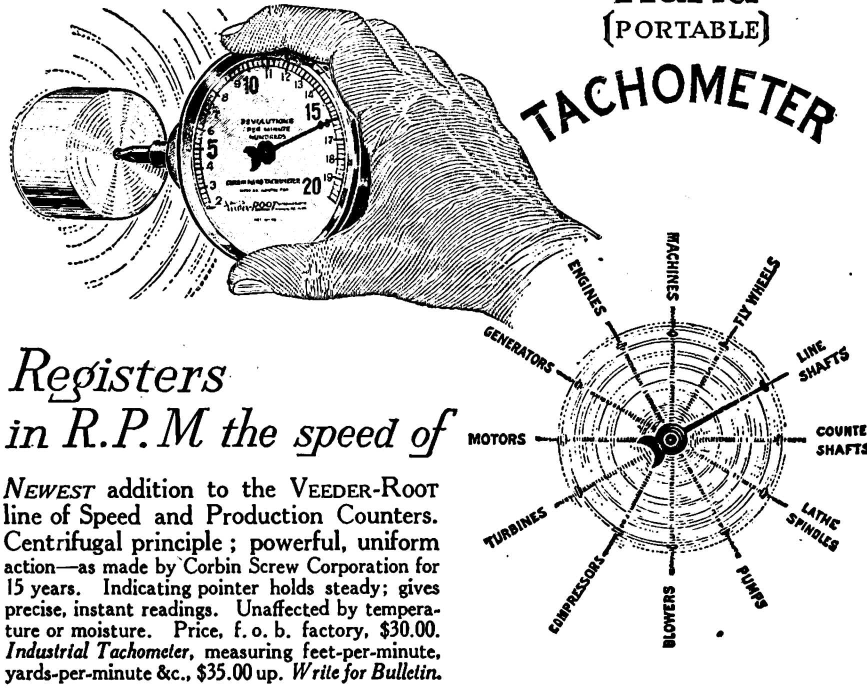
The FLORSHEIM *Shoe*

Most Styles $10

The Florsheim SHOE

Veeder-ROOT *Presents the* CORBIN

Hand (PORTABLE) TACHOMETER



Registers in R.P.M the speed of

NEWEST addition to the VEEDER-ROOT line of Speed and Production Counters. Centrifugal principle; powerful, uniform action—as made by Corbin Screw Corporation for 15 years. Indicating pointer holds steady; gives precise, instant readings. Unaffected by temperature or moisture. Price, f. o. b. factory, $30.00. *Industrial Tachometer*, measuring feet-per-minute, yards-per-minute &c., $35.00 up. *Write for Bulletin.*

Veeder-ROOT INCORPORATED HARTFORD, CONN.

OFFICES IN PRINCIPAL CITIES; WRITE OR PHONE

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

AMATEUR
TELESCOPE MAKING

The results obtained by several hundred makers of telescopes attest the worth of this book, for all they know was obtained from it.

$3.00 *postpaid domestic*

SCIENTIFIC AMERICAN

The Musical Sensation
ACCORDEON
Played by Music Rolls

Without any knowledge of Music or Notes, you play in a few minutes, as perfect as an Artist, latest hits, songs and dances. Every instrument guaranteed. Circular No. F and roll list mailed free.

TREASURE SALES CO.
1690 Boston Road New York

The famous Matthews
"38" Stock Cruiser
Speeds 15 to 30 miles
Go anywhere in a
Matthews Cruiser
"Matthews 38"

ENJOY THE PLEASURES OF CRUISING
Matthews "38"
Single Cabin, Double Cabin, Sport Cruiser, Day Cruiser
Matthews "34" Speed Cruiser
Matthews "46"
Double Cabin, Single Cabin, Sport Cruiser
Ask for Folder L
THE MATTHEWS CO., Port Clinton, Ohio, U. S. A.
Quality Service Since 1890

RADIO FREE CATALOG
AT WHOLESALE PRICES
196 pages of radio bargains. New Screen Grid, all-electric, A.C. Sets in beautiful consoles—also battery operated sets as low as $15.95. Write today.
ALLIED RADIO CORPORATION
711 W. LAKE ST., DEPT. 67 CHICAGO

ASBESTOS
All grades of Crudes
and Fibres in large
or small quantities
Sold by
KEASBEY & MATTISON
COMPANY
Ambler, - Penna.
Branches in Principal Cities

same pages over again. Masterpieces of literature and important historic documents thus may have been wiped out in order to preserve facts that seemed of greater value to the later makers of manuscript books. Now, a communication to the British journal *Antiquity* reports that a method of photographing the invisible writings has been found.

To photograph the ghost writing a mercury vapor lamp which generates ultraviolet rays is used. A filter of glass almost black in color transmits only the ultraviolet rays. When examined beneath these rays, many dyes and other substances take on a curious glow, or fluorescence, each substance exhibiting a characteristic color. By using a special filter it is possible to eliminate the surface writings and to photograph only the lost script.

It has sometimes been possible in the past to restore invisible writings by use of chemicals, but the processes were damaging and not very satisfactory. The new method will enable scholars to probe into the past of any manuscripts, however valuable, and to make the ghosts not only "walk" but "talk."—*Science Service.*

Bees' "Sweet Tooth" Scientifically Measured

THE far-famed "sweet tooth" of the bee has a sound scientific basis, according to a report on the chemical senses of insects by Dr. Dwight Elmer Minnich of the University of Minnesota, appearing in the *Quarterly Review of Biology.*

Tests made by a German scientist to determine the reaction of bees to the four classic tastes, sweet, sour, salt, and bitter, that are not dependent on the sense of smell, show, said Dr. Minnich, that bees will take saccharose solutions eight times as strong as man can tolerate. The bees' reaction to acidity and to salt solutions, however, was roughly analogous to that of man. On the other hand, they would swallow solutions much more bitter than the experimenters in the research laboratory could stand.

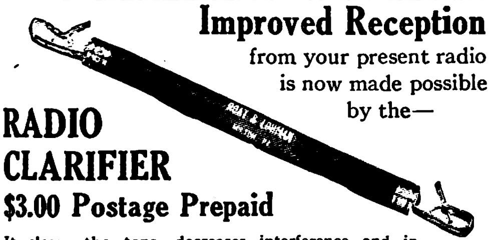
Experiments with butterflies undertaken by Dr. Minnich brought to light the rather surprising fact that some of our common wayside butterflies taste with their feet. From this circumstance the entomologist argues that the gustatory nerve centers for these species are located in the tarsus, the division of the insect's leg to which the feet are attached.—*Science Service*

Iron Wire in Acid Acts Like Nerves

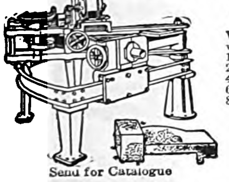
A STRIKING similarity between nervous action, particularly heart action, and the behavior of iron wire in a nitric acid bath has been discovered and studied by Ralph S. Lillie, professor of physiology at the University of Chicago. He has been working out the analogy for several years and it forms a significant part of his theories concerning nervous action which have been published in book form and, more recently, in *Science.*

According to A. J. Carlson, chairman of the Department of Physiology at the University of Chicago, the study of this similarity is of fundamental importance in the acquisition of knowledge concerning nervous action. "The obscure problems of physiology," said Dr. Carlson, "and the problems difficult to work out on experi-

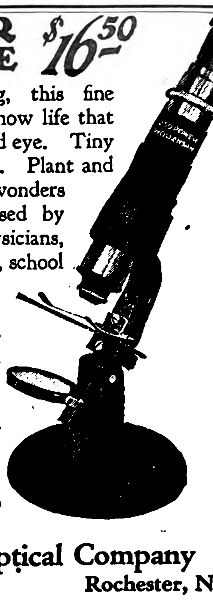
RED-1207
UNIQUE Trade Mark Regd.
THIN LEAD
COLORED PENCILS
24 Colors
Make fine lines in color
Perfect for making neat, small figures, notations, check marks, etc. in color. Better than ink for clean, thin-line underscoring. Ideal for sketching and drafting. Sharpen in a pencil sharpener to a needle point.
$1.00 per dozen
Per Box
Asst. No. 1116 (12 colors) $1.00
Asst. No. 1117 (24 pencils) $2.00
At all dealers or write direct
American Pencil Co.
542 Venus Bldg.
Hoboken, N. J.
A VENUS Pencil Factory Product



Improved Reception
from your present radio is now made possible by the—
RADIO CLARIFIER
$3.00 Postage Prepaid
It clears the tone, decreases interference and increases volume. Overcomes fading of sound. Good for any wave length. Easily installed on inside or outside aerial. Simply cut wire near cabinet and connect between cabinet and aerial by using clips which are attached to Clarifier. Gives wonderful results. Satisfaction guaranteed. Worth many times its cost. Send $3.00 for immediate delivery. Descriptive literature on request.
ROAT & LOHMAN, Dept. 404, Milton, Pennsylvania



"WONDER" Cold Pipe and Tubing Benders
Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe our way, per bend:
1-inch pipe . . . . . . 5 cts
2-inch pipe . . . . . . 10 cts
4-inch pipe . . . . . . 25 cts
6-inch pipe . . . . . . 60 cts
8-inch pipe $1.00
American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.
Send for Catalogue



250 POWER MICROSCOPE $16.50
MADE IN U.S.A.
Educational, entertaining, this fine microscope helps all to know life that can't be seen with unaided eye. Tiny insects look like monsters. Plant and mineral life reveal new wonders in form and color. Used by students, dentists, physicians, scientists—in home, office, school and laboratory. Precise optical qualities.
Magnifies 100 to 250 times. Tilting stand, fine finish, nickel trim, plush-lined case, prepared slide, instructions. At your dealer or direct postpaid. Money back guarantee. Other models $2.50 to $8.50. Catalog Free
Wollensak Optical Company
913 Hudson Ave. Rochester, N. Y.

mental animals must be approached through study on easily controllable materials. The work of Dr. Lillie on the iron wire, because it yields results so similar to the observable phenomena in living nerves, is highly suggestive with reference to further research and ultimate knowledge."

The freakish behavior of pure iron wire in nitric acid has long been known but it was not until Dr. Lillie began his experiments that the almost startling similarity with living nerves was discovered. In a popular demonstration of the experiment, a pure iron wire, 1 to 5 centimeters long, is immersed in a bath of nitric acid of 60 to 80 percent. A colorless film immediately forms over the wire. If the wire is scratched at one end, a wave travels rapidly along the wire. If a small glass tube is placed in the acid around one end of the wire, rhythmical waves pass the length of the wire at a rate of from 14 to 120 times a minute, depending on the strength of the solution, the temperature, and the length of the wire.

What happens, according to Dr. Lillie, is that a sort of battery is formed. The film, which is the thickness of only one molecule, has an electrical charge negative to that of the wire. When the film is scratched, a current sets up which dissolves the film next to the bare spot. This continues until the bare spot, which is seen as a wave, has passed the length of the wire. The film forms again after the wave has passed. The glass ring at one end of the wire establishes an area of permanent activity because the acid becomes less concentrated. Thus, as if the film were being continually scratched, rhythmical waves pass along the wire as rapidly as the film is re-formed. "The process may be regarded," says Dr. Lillie, "as a two-dimensional explosion."

The analogy to nervous action is emphasized by the effect which outside factors have upon the rhythm of the wire. The influence of temperature, electrical polarization, concentration of acid, and length of the wire, have been shown by Dr. Lillie to be the same as the influence of these factors on living nerves.—*Science Service.*

American Passenger Air Transport

(*Continued from page* 329)

indicated in an interior view on page 329.

Three or four years back, airplane constructors and operators, both in Europe and the United States, seemed to come to the conclusion that 100 miles per hour cruising speed was as fast as an airplane had to go, and that economy and load carrying capacity were more important than further increase in speed. But the sole justification of the airplane lies in its speed, and designers have found it possible to go well beyond the 100 miles an hour mark. A cruising speed of 130 miles an hour is not uncommon, 150 miles is well in sight, and well informed men are of the opinion that 200 miles an hour is not an impossibility, particularly if such methods as refueling in the air are resorted to.

Of course there is a difference between the cruising speed and the scheduled speed that can be maintained in practise, allowing for stops and head winds. We will consider speeds now to be found on a few typical routes.

The Heart of Every Action Device
Upon the motor depends the satisfactory performance of every motor-driven device...steady and increasing sales depend upon performance.
Especially designed for motor-driven devices are Signal fractional horsepower motors, either induction or series-wound...back of them are correct principles of design that embody every essential of a satisfactory small motor...a guaranteed performance that meets any manufacturer's requirements for motor-driven appliances...
Send us your motor problems...we have been designing and building small motors since 1890...today we're meeting many manufacturers' needs...write
SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan
Small motor specialists since 1890
SIGNAL MANUFACTURERS OF ELECTRICAL PRODUCTS

TYPEWRITER ½ Price
World's best makes—Underwood, Remington, Royal—also new portables—prices smashed to below half. (*Easy terms*).
SEND NO MONEY!
All late models completely rebuilt and refinished brand new. *Guaranteed* for ten years. Send no money—big *Free* catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10 day free trial offer. Amazing values—send at once.
Free Trial
International Typewriter Exch., 231 W. Monroe St. Dept. 1060, Chicago

SCIENCE NEWS-LETTER
offers
Life-Continuation Courses
SCIENTIFIC progress is so rapid and revolutionary nowadays that no one can keep up with it without constant contact.
The weekly, Science News-Letter, endeavors to provide "life-continuation" courses *in all sciences.*
With life so complex, it is important that the people as a whole should so far as possible, understand the aims and achievements of modern science. Not only because of the *value of such knowledge* to themselves but because research directly or indirectly depends upon popular appreciation of methods.
For individuals and libraries wishing the cream of scientific news, Science News-Letter is published each week.
Introductory Offer—$2 for 6 months
Science Service
2177 B St., Washington, D. C.

Electricity!
Learn in Los Angeles

Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00 — unlimited opportunities now.

Practical, intensive training by National's job-experience method in 6 to 9 months. All technical essentials included. School endorsed by leaders in electrical industry. You learn all branches of electricity; radio. Million dollar institution; all modern equipment and training facilities. Life scholarship. No age limit. Free employment service. Over 17,000 successful graduates. 23rd year. Big, illustrated 84-page catalog sent FREE. Write today.

FREE BOOK

NATIONAL ELECTRICAL SCHOOL
Dept. 302-EC 4006 So. Figueroa, Los Angeles, Calif.

"14 WORDS OF MAGIC POWER"

FREE —that is what the multi-millionaire gave to the young man who saved his life. 14 WORDS that created the rich man's millions. The young man *used* them. They made *him* worth a *quarter of a million dollars in 5 years.* Do you want to know what these words were—and how you can use them? A fascinating little book tells the story. It is yours free IF you are a young man 16 to 32 years of age and willing to consider using a part of your spare time preparing for a worth-while position in the big pay fields of Drafting, Engineering, Electricity or Architecture through any one of these three plans:

1. 1, 2 or 3 yr. training at Chicago Tech. Diplomas and B. S. Degrees. Opportunities for self-support. Day and Evening classes—or
2. A short 4 months' special course in Drafting. Quick preparation. We help you secure position when through training—or
3. Train at Home in Drafting. Keep your present job and prepare for a better one in spare time. All tools supplied without extra cost.

This Free Book is yours—if you write for it and indicate the plan (by number) that interests you.

ADDRESS: DEPT. N-57, CHICAGO TECHNICAL COLLEGE, 118 East 26th St., Chicago, Ill.

WANTED MEN
To Manufacture Metal Toys and Novelties

Big demand for Toy Soldiers, Animals, 5 and 10c Store Novelties, Ashtrays, etc. We co-operate in selling goods you make also buy them from you. Small investment needed to start and we help you build up. WE FURNISH COMPLETE OUTFITS and start you in well paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life time for man with small capital. CHRISTMAS RUSH is now starting, so if you mean strictly business write AT ONCE for full information.

METAL CAST PRODUCTS COMPANY
Dept. S 1696 Boston Road New York City

LEARN WATCHMAKING AND ENGRAVING
By Our Profit-Sharing Plan
OUR GRADUATES SUCCEED

One of our Iowa students started in a very small way—now doing over $30,000 a year. Another in Wisconsin, over $10,000 the first year. Day or night classes. Call or write for FREE BOOK.

Chicago School of Watchmaking
Dept. 5604, 549 W. Randolph St., CHICAGO

VACUUM CLEANER MEN—Your selection of 30 leading makes, rightly rebuilt vacuum cleaners. **From $5.00 up.** All fully guaranteed. Perfect in action and appearance. Any quantity desired. Biggest vac bargain ever offered. **Here's real money for you. ATTACHMENTS,** bags, belts, brushes, all other parts, **and new specialties.** Highest quality. Lowest prices. Complete FREE Catalogs. World's Largest Factory Rebuilders.

UNITED ENTERPRISES, INC.
13030 Athens Ave., Cleveland, U. S. A.

Earn More Money in California!
$40 to $75 a week for Auto Men

Don Sterling makes $75 a week, Victor Wright, $60 a week, Paul Briggs, $4000 a year—all because of National training. Big opportunities for you, too, in California. National will train you in a few weeks as auto mechanic, electrician salesmen, etc., to fill big pay jobs now open—$40 to $75 a week. Million dollar school established 1905, thousands of successful graduates. New method of practical shop training insures your success.

EARN WHILE YOU LEARN

Our free employment service finds you a spare time job, if you wish. You can earn while you learn.

FREE Auto Book

FREE! Special $75 course in salesmanship and garage management, for limited time only. Mail postal or write for big free eighty-four page auto book, with 150 illustrations—gives all facts.

NATIONAL AUTOMOTIVE
Dept. 802-AC, 4004 South Figueroa
Los Angeles, California

Miami to Havana, large three-engined plane, no stops, 261 miles in 2 hours 15 minutes, or 116 miles per hour.

Kansas City to Los Angeles, in a Fokker tri-motored *F-10*, with five intermediate stops, 1917 miles in 13 hours 5 minutes, or an average of 108 miles per hour.

St. Louis to Omaha, in a single-engined six-passenger plane, with a stop at Kansas City, 401 miles in 4 hours 40 minutes or 86 miles per hour.

Tulsa-Oklahoma in a single-engined six-passenger plane with two intermediate stops, 132 miles in 2 hours, or 66 miles per hour.

Chicago to Detroit, in a three-engined Ford plane, 250 miles in two hours and a half or 100 miles per hour.

It would appear that in the large modern airplane an average scheduled speed of over 100 miles per hour may readily be expected. The best trains maintain an average of 50 miles per hour, but distances by rail run 25 percent more than by air between any two points. The advantage of the plane is already tremendous and it will grow.

It may be of interest to reproduce the following table prepared by the Boeing Company.

San Francisco to	Rail Miles	Air Miles	Train Time	Air Time
Sacramento, Cal.	85	85	2 h. 44 m.	0 h. 45 m.
Reno, Nev.	239	184	8 h. 55 m.	1 h. 45 m.
Elko, Nev.	546	419	16 h. 55 m.	3 h. 45 m.
Salt Lake City, Utah	814	624	24 h. 0 m.	6 h. 30 m.
Cheyenne, Wyo.	1335	1041	38 h. 30 m.	10 h. 40 m.
Omaha, Neb.	1840	1517	49 h. 45 m.	14 h. 25 m.
Chicago, Ill.	2328	1943	61 h. 45 m.	19 h. 40 m.

Let us now consider the average fare, and select a few typical cases as a basis for an estimate.

Miami-Havana, operated by Pan American Airways, 261 miles, 55 dollars one way, or 21 cents a mile. This is perhaps the highest fare charged.

Western Air Express charges 33 dollars for the 365 miles between Los Angeles and San Francisco, which works out to 9 cents a mile.

Stout Air Lines covers the 128 miles between Detroit and Cleveland for 14 dollars or 9.1 cents a mile.

Somewhere around 10 cents a mile would appear to be a fair average figure, which is perhaps twice as much as the cost of travel on the best trains. When time saved is taken into account, these prices are not likely to alarm the business man to whom speed of transportation is a highly important factor.

OUR readers may ask whether with these fares, the air lines are likely to pay their way.

From reports to the Department of Commerce, it appears that costs for multi-engined planes vary from $.753 to $1.07 per mile, while the single-engined 200 horsepower plane averages $.71. Large machines loaded to nearly full capacity should therefore be profitable, even without the help of airmail. Small passenger planes would not appear to be so profitable an undertaking at the moment. Of course, further experience is necessary before passenger operators can really settle the problem of a remunerative fare that will be satisfactory to all concerned.

Prospective travelers will be interested in the charges for baggage. As the carrying capacity of the airplane is strictly limited, operators cannot afford to be liberal in the matter of baggage. Twenty-five to thirty

Bond STANDARD STOCK GEARS
Stocked for immediate shipment in large industrial centers
Send for Catalog 54-S
CHARLES Bond COMPANY
617 Arch St., Phila., Pa.

GEARS
All Kinds—Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

BECOME A FOOT CORRECTIONIST
$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

World's Wonder Wrench
Banishes Old Style Wrenches!
Pays Agents $20 Daily
New! Different! Never a nut wrench like "Speednut." Chicago Auto Show sensation. Automatic! Ratchets! Can't slip! The harder it's pulled, the tighter it grips! A whole kit of wrenches in one. Has 23 wonder features. Priced low with big profits to you. Enormous demand. FREE Demonstrator Offer starts you writing orders from tool users, car owners, factories, shops. Part or full time. No stock investment. We deliver.
Speednut Corp., 190 N. State St., Dept. 60, Chicago

SPRINGFIELD RIFLE, Model 1903
$19.50
Assembled and Refinished
8¾ pounds, 43 inches long, 24 inch barrel. Offered without bayonet, $19.50. Packing charge 50c extra. Ball cartridges $3.50 per 100. New catalog, illustrated, 380 pages of Army-Navy equipment, pistols, guns, uniforms, saddles, for 50 cents.
Special new circular for 2c stamp. *Established 1865.*
Francis Bannerman Sons, 501 B'way, N.Y. City

ASTRONOMICAL TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.

Waterpower Engineering Home Study
H. von SCHON, Consulting Engineer
289 Parker Street, - Newark, N. J.

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

BOILER FEED WATER TREATMENTS
of purity and all other required characteristics.
Pamphlet on request
SIME, DARBY & CO., Singapore, S. S. *Agents for Straits Settlements.*
UNISOL MFG. CO., Jersey City, N.J., U. S. A.

ELECTRICAL PROBLEMS?
THE A. H. S. ELEC. SERV. & ENG. BUREAU, Rendering *Personal Service, will solve them for you through the Mail with Precision.* P. O. No. 132, FLUSHING, NEW YORK

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
STEEL LETTERS AND FIGURES
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
Labor Saving Machinery Designed & Built
Circular - References - Guarantee - Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

CRESCENT -TOOL- COMPANY
Inventors--We Build Models
Send us your rough idea. Our Master Mechanics will develop it for you into a practical working Model. Thirty years successful experience doing this very thing. Best shop equipment. Expert advice. Confidential service guaranteed. Bank reference furnished. Send for free booklet "The Road To Success."
CRESCENT TOOL CO., Dept. C. Cincinnati, Ohio

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

PATENT FOR SALE
THE MOST WONDERFUL ONE QUARTER TURN HOSE CONNECTION for Air, Steam, Gas, Oil, Sand and Water, ever shown to the public. Price $5,000. Patent No. 1,591,871.
J. J. HEINRICH, 2135 South Michigan Avenue, Chicago, Ill.

PATENT FOR SALE
U. S. and Canadian Patents. A useful combination twine holder and cutter, wherein the twine may be cut after a desired length of same has been removed from the holder. Will sell outright or on a royalty basis. Address
R. SALVAGGIO
1330 Magazine Street, New Orleans, La.

Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE

At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.
$5.00 for Complete Outfit Prepaid
ROAT & LOHMAN
Dept. 102 Milton, Pa.

pounds are generally allowed free, with a charge of 50 cents per pound for additional weight. Some companies allow no free baggage but charge a low rate per pound.

In at least four cities "air travel consolidated ticket offices" are to be found. The first was established by Air Associates in New York City, the second in Los Angeles under the auspices of the Automobile Club of Southern California, a third in Chicago, and a fourth in the premises of the Cleveland Automobile Club. They are all busy and rendering a much needed service.

NO matter how safe air travel may be, the questions of the liability to passengers of the carrier and of insurance will naturally interest all.

At present the exact responsibility of an aircraft operator to his passengers is difficult to determine, owing to lack of legal precedent. Major G. L. Lloyd, an authority on aviation insurance, in a paper read before the International Civil Aeronautics Conference in Washington seems to be of the opinion that an airline operating on regular schedule will have all the liabilities of a common carrier and perhaps some additional ones owing to the somewhat greater hazard of flying.

A signed release from liability given by a passenger before a flight should be slight defense under the common law, if negligence can be clearly established. Of course there will be great difficulties in establishing negligence in aircraft accidents. It is to be hoped that our operators will adopt a liberal policy towards passengers in case of accidents, protecting themselves by taking out large policies for liability.

Insurance for passengers is now available in a number of ways. Coupons for specific flights on regular airlines, similar to the railroad accident ticket policies, can be readily purchased at rates varying from 75 cents to $1.50 per 1000 dollars per flying day, but the amount of insurance obtainable is limited. (We believe that rates are coming down and that two dollars will now buy 5000 dollars in insurance.) Annual policies are available from 15 dollars per 1000 dollars and upwards. Pan American Airways operating between Miami and Havana, Miami and Nassau, and Miami and San Juan include a 500 dollar accident insurance policy for each passenger in the price of the fare.

The practise of life insurance companies varies widely. A writer in *Air Travel News* has canvassed many large companies and finds the following practises:

Bankers, Iowa—occasional flights as passengers, no extra premium; Canada Life—no restrictions on passengers; Equitable, N. Y.—no restrictions on passengers; Home—occasional fliers treated on individual merits; Metropolitan—no restrictions for occasional fare-paying passengers; Mutual Life—occasional fliers and passengers at extra premium depending on flying done; New York Life—occasional flier extra rate depending on flying done; Travelers, occasional fliers given consideration.

There is no doubt that life insurance companies will adopt a more and more liberal viewpoint as passenger flying becomes more common. For the time being prospective passengers will do well to consult their companies whether with regard to policies already written or for new policies.

(To Be Continued)

At leading stores or Order Direct

HAMLEY
started something in Toilet Kits

The style in toilet cases has definitely swung to this solid-leather box... made by real saddle craftsmen from solid leather. A plain box, but such a box! No trick of design or finish can approach its rugged solid-leather honesty. Simplicity itself—no fussy loops to waste time in packing. A great gift! A wonderful utility. Order one now. At leading stores or by mail, postpaid, from Hamley & Company, world's champion Saddlemakers, 96 Court Street, Pendleton, Oregon.

Medium	• 8⅝ x 3⅞ x 1⅞	$ 6.00
Large	• 9½ x 4½ x 2¼	7.50
Extra large	• 10½ x 5⅜ x 2¼	10.00

• Inside measurements. Name or initials embossed on lid, 25c extra.

HAMLEY KIT
MADE OF GENUINE SOLID LEATHER LIKE A FINE COWBOY SADDLE

TRY OUR
BOOK SERVICE
SCIENTIFIC AMERICAN

SPARE TIME TRAINING *that leads to* BIGGER PAY

Do you want a better position and a higher salary? You can have these if you can do the work. LaSalle experts will show you how, guide you step by step to success and help solve your personal business problems through the time-saving LaSalle Problem Method. Our *salary-increasing plan* enables you to prepare during your spare hours, without interference with your present duties. Simply mark on the coupon the field in which you desire success, and we will mail you a valuable book describing the opportunities in that field, together with an outline of our *salary-increasing plan.* Also copy of "Ten Years' Promotion in One." There is no cost or obligation. Find out how the *salary-increasing plan* starts average men and women on the high road to success and financial independence. Check and mail the coupon NOW.

— — — *Find Yourself Through LaSalle* — — —

LA SALLE EXTENSION UNIVERSITY
The World's Largest Business Training Institution
Dept. 1051-R Chicago

Tell me about your *salary-increasing plan* for my advancement in the business field checked. Send also copy of "Ten Years' Promotion in One," all without obligation.

- ☐ Business Management
- ☐ Modern Salesmanship
- ☐ Higher Accountancy
- ☐ Traffic Management
- ☐ Railway Station Mgmt
- ☐ Railway Accounting
- ☐ Law—Degree of LL.B.
- ☐ Commercial Law
- ☐ Industrial Management
- ☐ Banking and Finance
- ☐ Modern Business Correspondence
- ☐ Modern Foremanship
- ☐ Personnel Management
- ☐ Expert Book-keeping
- ☐ Business English
- ☐ Commercial Spanish
- ☐ Effective Speaking
- ☐ C. P. A. Coaching
- ☐ Stenotypy
- ☐ Telegraphy
- ☐ Credit and Collection Correspondence

Name ____________________

Present Position ____________________

Address ____________________

Our Choice of Recent Books

Modern Scientific Knowledge

By Frederick A. Cleveland, Ph.D., LL.D.
Professor at Boston University

A 550 page well illustrated survey of modern scientific knowledge of nature, man, and society, written by 14 different scientists, some of whom are noted. It covers the sciences of astronomy, physics, chemistry, and biology; it also covers anthropology, psychology and sociology. The book was prepared to orient college freshmen in the whole field of science, before they began to specialize, and is therefore suitable for the general reader. It has schoolbookish earmarks but the style of the text matter is clear and lucid. $4.70 postpaid.

Meteors

By Prof. Charles P. Olivier, Dir. Observatory Univ. of Pa.

THIS is *the* standard work on meteors and comets, and is the last word. Written by "the principal American authority on the subject," to quote Professor Russell in the present number, some of the subjects treated are: how meteors are observed; comets; meteor showers; computation of orbits; theory of lunar craters; origin of meteors. $6.20 postpaid.

The Earth

By Harold Jeffreys, M.A., D.Sc., F.R.S., Prof. Cambridge Univ.

THE second and greatly revised edition of a noted book for the student of geophysics, the full title being "The Earth, its Origin, History, and Physical Constitution." Among subjects treated are: tidal theory of origin of solar system; origin of moon; age of earth; seismology; theory of isostasy. The treatment is largely mathematical but the mathematics merely prove the statements of the text and, as the author says, may be skipped if desired. The book is essentially for the student and presupposes some knowledge of astronomy and earth science.

$6.70 postpaid.

Elementary Mechanics

By J. J. Reynolds, Prof. Math. and Theoret. Mechan. Lehigh

NOTHING further than geometry, trigonometry, and algebra is required for a comprehension of this lucid and well developed text. All the material is of a very practical turn and the data avoid involved computations. A beginning course in technical analysis. $2.70 postpaid.

Elementary Organic Chemistry

By F. H. Constable, St. John's College, Cambridge

THIS concise summary broadly covers the whole ground and treats thoroughly most of the important topics in elementary work. Reactions common to a class are studied and then applied to a particular example. A general knowledge of practical methods and terminology is presupposed,

$2.15 postpaid.

Chemistry in Daily Life

By S. Glasstone, Ph. D. University of Sheffield

RATHER more extended and a bit more detailed than many of the books that have appeared on this subject. For this reason it is a more valuable reference and at the same time the presentation is so well considered that none of the aspects of a text are appreciable. $2.40 postpaid.

The Science of Psychology

By R. H. Wheeler, Univ. of Kansas

BASED upon laboratory analysis and experimental investigation including measurement of social attitudes, animal and child behavior, influence of social environment, et cetera, this treatise considers the subject upon the principle that parts are to be explained in terms of the whole, not wholes in terms of parts. A new and interesting treatment which is readily acquisible. $4.00 postpaid.

Principles of Economics

By F. S. Deibler, Prof. Economics, Northwestern Univ.

THE scope of this work is confined to the more general and basic principles. Seventeen well-known economists and industrial leaders here present the results of their study of economic changes in this country since the war. The survey which furnished the background was conducted with unprecedented thoroughness. More than two hundred experts and a large number of organizations collaborated.

$7.70 postpaid.

Money

By Samuel Crowther

HOW to make, use, and invest money. The writer has been co-author of works with some of our most successful industrialists and sets forth his ideas in pungent, straight-to-the-mark sentences which carry many of the characteristics of the men with whom he has associated. Well worth careful perusal. $2.15 postpaid.

Raw Materials of Industrialism

By H. B. Killough, Asso. Prof. Economics, Brown Univ.
L. W. Killough, Asst. Prof. Economics, Wellesley

ALL the raw materials of the world are surveyed to arrive at a basis of trade and commerce by dividing the subject into five parts: textile fibers, crude forest products, population and food supply, minerals, and fuel power. A comprehensive resumé of wide research. $3.90 postpaid.

Aerial Navigation and Meteorology

By Lewis A. Yancey

WRITTEN by the man who accompanied Lieut. Williams on his recent flight to Rome, this revised and considerably enlarged edition is a practical, non-technical manual for aircraft pilots, students, and general reference. It describes the instruments and their use in aerial navigation, air commerce regulations, applications of meteorological information and is withal an excellent practical guide.

$4.20 postpaid.

Oxy-Acetylene Welder's Handbook

By M. S. Hendricks, Ed. The Acetylene Journal

A VERY concise (4⅜ x 6⅝, 208 pages) volume covering in logical and convenient form all the considerations which are inherent in the best practice. Enough of the metallurgical aspects are included as seem essential to a good understanding of the "why" of certain practices. An interesting chapter on welding properties of common metals is admirable.

$3.15 postpaid.

Roadside Development

By J. M. Bennett

WE have all passed through country where a new wonderful road has been built, but the scars of its accomplishment have bitten into our consciousness until we wondered if too big a price in natural beauty had not been paid. The author, with years of experience and study, has innumerable practical suggestions which make for conservation and beauty with utility. A most entertaining, practical, and excellent book. We highly recommend this unique study to property owners, public utility corporations, and all those who are interested in or vote on highway improvements. Abundantly illustrated.

$5.20 postpaid.

Kings of Commerce

By T. C. Bridges
H. H. Tiltman

HERE are twenty-six sketches of the lives of men who attained unique success in business. Many of these are Englishmen, much of the material being new as far as we in this country are concerned. Twenty-four interesting photographs of the subjects of the sketches are reproduced. $3.15 postpaid.

The Story of the Baltimore & Ohio R. R.

By Edward Hungerford

PURSUANT to its one hundredth anniversary, this railroad's history, which is as well the record of the social and economic life of the territory it serves, has been set down with most entertaining manner in a spirit which well reflects the importance and color of so large a factor in our early development. One reads through the two volumes with the many illustrations scarcely realizing the extent of the text nor the faithful research which made the story possible. $10.00 postpaid.

Sea Lore

By Stanley Rogers

NOW that sailing vessels have all but disappeared from the high seas, a book of this kind has a distinct place in literature for its historical importance. The details of rigging and design are authentic, coming from an accurate study of original sources. 125 illustrations are drawn by the author.

$2.90 postpaid.

Pioneer Heroes

By J. Walker McSpadden

COMPANION book to "Indian Heroes" which appeared last year, this tells the story from the white man's standpoint. The author has a gift of combining historical fact with a most readable style. This is the type of American history one can heartily recommend. $2.15 postpaid.

Long Ago Told

By Harold Bell Wright

WITH enthusiasm we recommend this latest work of one of our most popular writers. For years he has lived near the Papagos Indians, studying their ancient lore, manners, customs, and rites, and absorbing their tales by the fireside. Having won their trust and affection he sets forth with his characteristic fidelity to geographic and personal detail, many of their beautiful legends which are clothed in appropriate simplicity of expression and feeling. A worthy contribution to the literature on the Indian.

$2.50 postpaid.

Internal Combustion Engines

By L. Streeter and Lester Clyde Lichty

A THOROUGH revision of this standard textbook on the fundamental principles of the theory and design of internal-combustion engines. The treatment of the combustion process, of cycle efficiencies, of the cooling of engines, and of the carburetion of liquid fuels has been thoroughly revised to include the latest data available. $4.20 postpaid.

For Sale by **SCIENTIFIC AMERICAN**

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Mechanical Wonderland

INVENTORS, and all others who may wish to see a remarkable display of working models illustrating fundamental principles of mechanics, will be interested in the "mechanical wonderland" in operation at the Museum of the Peaceful Arts, in the Scientific American Building, 24 West 40 Street, New York City. More than 200 working models, simplified and built to a scale which readily shows the essential principles involved, are arranged in such a way that the visitor may study fundamental principles of physics and methods, old and new, for the ultilization, direction, and transformation of various forms of energy.

The display was designed by William Clark, who turned his mechanical ingenuity to the task of creating a moving display which would present important mechanical principles with such simplicity that they may be understood by the layman. By assembling the working parts of his models in convenient sizes, with cut-away sections to reveal the action which takes place as the devices are operated, the designer has presented the wonders of mechanics in somewhat the same way a showman marshalls the creatures of the animal kingdom. His original plan was to make a tour of the country with the "mechanical circus."

Although all of the models shown in the exhibit are representations of common mechanical principles and their application for various uses, many visitors entertain some doubts as to whether there is some trick behind the operation of such devices as square gears, out-of-line and eccentric drives, peculiar pulley arrangements, and universal joints which simulate the involved gyrations of a clever contortionist.

In addition to the numerous industrial applications of the various mechanical principles, the display reveals also the *modus operandi* of such devices as watch and clock escapements, and various household devices. A particularly popular part of the exhibit shows the operation of 12 of the essential parts of the modern motor car, in cross sectional detail, including the internal combustion engine, carburetor, steering arrangement, brakes, transmission, and differential drive.

Hair Waving Apparatus Patented

DIFFERING from the prior art in that it is adapted for use only once, a new apparatus for waving hair has been been awarded a patent. Former inventions covering heating coils having permanent form and intended for continuous use were held by the Board of Appeals to contain no suggestion of the apparatus revealed in the petitioner's application.

The patent was allowed after two of the claims had been amended; several claims were dismissed from the appeal, and the action of the examiner in rejecting five other claims was upheld.

The new apparatus consists of a flexible envelope to enclose the prepared strand of hair, a pad for holding moisture to be vaporized in the envelope, and an electrical heating coil; the three parts are formed into a collapsible tube. The ends of the coil are adapted for detachable connection with a wire leading from a source of current. After being used once, the apparatus is discarded.

Patentability of Combination of Prior Practices Upheld in Infringement Suit

PATENTS covering a process for applying plaster to concrete and masonry walls and ceilings were held valid and infringed in a recent decision of the District Court for the District of Maryland in favor of the Vortex Manufacturing Company, et al.

The novelty of the infringed patent (Parkin Number 1282460), according to the court, resided in the application to walls and ceilings of a moisture-impervious fluid bond material at normal temperature, together with the application of an inert material, and the plaster. While the prior art disclosed the various features of the invention, none of the earlier inventions suggested the co-operation of elements upon the principle adopted by the patent in suit, since none of the prior patents called for the application of asphalt to walls at normal temperature, in conjunction with the application of gravel and then plaster.

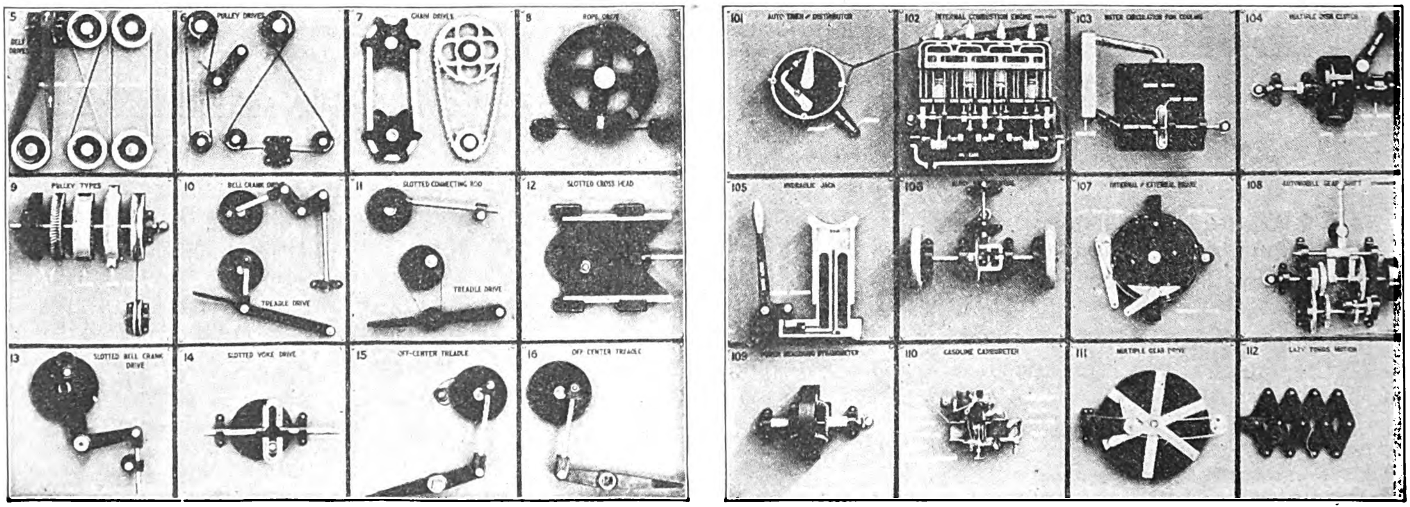
Because of the commercial success of the process, which is indicative of its utility, the court held that doubt as to patentability should be resolved in favor of the patent. The burden of proof as to infringement rests with the plaintiff, while the burden as to invalidity and anticipation rests upon the defendants.

The true test of the patentability of a combination of prior processess, the court stated, is whether there has been brought together for the first time their different elements into a unitary whole forming a process that is both new and useful. The Parkin patent was found to meet this test.

Mark Refused Registration—Held Ornamentative Only

WHETHER a mark functions as a trademark depends upon the impression it produces upon the mind of the public, according to a statement made by Assistant Commissioner in ruling that the McDougall Company, of Frankfort, Indiana, is not entitled to register a pictorial representation of a teapot with steam issuing from the spout, as a trademark for kitchen tables and cabinets. Registration was refused on the ground that the symbol is merely ornamental, and was not used as a trademark.

Although it could not be said that a representation of a teapot is descriptive of kitchen cabinets and tables, when the teapot is shown by itself, when applied to other articles it indicates that the table or cabinet is to be used in the kitchen, according to the ruling. Moreover, the mark renders the table more ornamental. The specimens filed show a table having a figure of a teapot at the four corners of the central panel and



Views of two sections of the mechanical wonderland described above centrally on each of the drop leaves, just above the lower edge. The Assistant Commissioner ruled that the mark directs the mind to the table and the proposed use of the table, and does not serve to indicate or suggest ownership or origin.

Thomas E. Murray, Noted Inventor, Dies

FEW American inventors have attained success as noteworthy as that which marked the rise of Thomas E. Murray from obscurity as a machinist to wealth and prominence as an inventive and executive genius. At the time of his death, which occurred on July 21st at his Long Island summer home, the 69-year-old inventor had been granted more than 1100 patents; most of them were confined to the development of electrical and gas appliances, but almost every phase of modern industry has been influenced by his work.

During the World War, Mr. Murray perfected a method of welding shells, and invented a process which resulted in the manufacture of 240-millimeter mortar shells. For these contributions he received high commendation from the War Department. For his numerous inventions of safety appliances, the Franklin Institute awarded him the Longstreth Medal of Merit. Mr. Murray's ability as an executive overshadowed his inventive genius, and at the time of his death he was known chiefly as the organizer and former executive head of the allied Edison companies, which supply electric light and power for the New York metropolitan area.

New Process Patented for Mining Sulfur

A PROCESS for mining sulfur by underground fusion with hot water has been patented by Wilbur Judson, as an improvement on the Frasch process by which abandoned mines may be operated. Several claims in the Judson application were held unpatentable, including one directed broadly to "the conservation of hot water by balancing underground pressure," which was held to be for a result without including the means to accomplish it. Other claims covering a process for mining sulfur, simply stating that the desired underground pressure may be obtained by introduction and withdrawal of water, were held unpatentable also.

The claims allowed are directed to a process for mining sulfur, setting forth the feature of maintaining a predetermined or balanced pressure in the underground sulfur deposit, by withdrawing cold water from the lower portion of the deposit and hot water from the upper portion of the deposit, and the re-introduction of the withdrawn hot water, with or without purification.

Joint Use of Trademark Upheld; Oral Assignment Invalid

IN a suit for infringement of a registered trademark, in which the appellee had entered a counter-claim for affirmative relief based on its ownership of the same trademark, both bills were dismissed by the Circuit Court of Appeals for the Second District. It was found that the appellant had at least impliedly consented to the use by the appellee of the trademark in question, and that the appellee's registration of the mark at a later date was ineffective. The suit was brought by Alfred G. Belden against Sophar Mills, Incorporated.

It was decided that since the appellant took the appellee into the business of A. G. Beldon and Company, in which the trademark "Pycnoleum" was used on lubricating compounds, belt cleaners, et cetera, the appellee was entitled to continue use of the mark after appellant severed business connections and established his own business. On the other hand, the court ruled that a registration of the mark obtained by the appellee in its own name immediately after appellant severed business relations was ineffective because the mark was a symbol of the Belden company's trade.

The opinion also holds that an oral assignment of a trademark right is ineffective to transfer title, it being stated that such an assignment must be in writing, and is void unless recorded in the Patent Office within three months from its date. The appellee was not held liable for infringement for continuing the use of the trademark.

Federal Trade Commission Backs Cut-Rate Druggists

IF your druggist sells Hooligan's Half-Dollar Hose Supporters, and decides to mark them down to 19 cents, that is his privilege. And if the House of Hooligan, or anyone else, should seek to persuade him to desist from the practice, he may simply say, "Will you please go to the Federal Trade Commission?" The illustration is rather fanciful, but it is one way of saying that the Federal Trade Commission stands back of the brand of competition practiced by the cut-rate druggists, et al.

In a recent ruling, the Commission ordered Johnson and Johnson, manufacturers of medical and surgical supplies, to desist from their established practice of seeking to control the retail selling price of "Johnson's Toilet and Baby Powder." One phase of the company's efforts to maintain a fixed uniform selling price for its products was to send a printed communication entitled, "Notes Concerning Resale Prices," to the 30,000 retail stores with whom it deals directly. The notice specified a minimum resale price, an amount designed to give the merchant a "reasonable" profit under ordinary circumstances.

But such practices and "agreements" prevented retail merchants from selling the goods at lower prices, according to the Commission, and such reductions might be warranted by trade conditions generally. Competition must be allowed to thrive, everyone will agree. It is evident that modern business, exemplified by the amazingly successful chain stores, has little regard for the quaint, old-fashioned policy, "Live and let live."

Manufacturers interested in the welfare of independent dealers have tried to protect the "little fellows" from the cut-throat competition of the chain organizations, with very little success. In the Colgate case, the Supreme Court of the United States made a sweeping decision to the effect that a manufacturer can refuse to sell his goods to any dealer, just as a dealer has the right to buy from whom he may choose. This was modified, in effect, by the Beech Nut Packing Company case, and others. However, as long as a manufacturer refrains from making "agreements" in restraint of trade, by using printed lists of resale prices or any other means frowned upon by the Federal Trade Commission, he can refuse to sell to any store or chain of stores whose methods he may dislike. As modern business is constituted, such a practice is bound to have little effect.

Registration Denied Because Applicant Had Not Shown Trademark Use

RULING that the applicant had not shown trademark use of a mark for which it sought registration, the First Assistant Commissioner of Patents recently upheld the decision of the examiner against the petition of the Toledo Scale Company. The mark in question included an outline of an elongated label bearing the words, "Toledo Scale Company," and beneath them the notation, "Silvite," under which were placed the words, "Rust Resistent Finish," and under that, "Toledo, Ohio, U.S.A." The application was for a trademark to be used on electroplated metallic finishes.

In denying registration for the mark, it was pointed out that the applicant sells no separate goods adapted to be used as a finish upon either articles, but merely sells the scales and the scale parts with the finish

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Chemical Processes

PROCESS OF PRODUCING CALCIUM CARBIDE AND PIG IRON—Combining the two processes into one operation, allowing the iron oxide to be reduced in the manufacture of calcium carbide without increasing the cost so that the reduction of the iron is accomplished without expense. Patent 1719970. Hilliary Eldridge.

Designs

DESIGN FOR A DECORATIVE MOULDING—Patent 78884. De Escott Green.

DESIGN FOR A LIPSTICK HOLDER—Patent 78886. Harry B. Grubb.

DESIGN FOR A CIGAR LIGHTER—Patent 78877. Richard A. Cromwell.

DESIGN FOR A TURBAN—Patent 78890. Dorothy Long.

DESIGN FOR A CANDLESTICK—Patent 78984. Mac W. Reh.

DESIGN FOR A SHOE HEEL—Patent 79073. Sol Greenwald.

DESIGN FOR A COMBINATION FOUNTAIN PEN AND PENCIL—Patent 78794. Craig R. Sheaffer.

Electrical Devices

ELECTRIC HEATER—Adapted to be embodied in the form of a hot water bag, the electric elements being associated with heat absorbing and radiating elements, resulting in a quick heating and a comparatively slow radiation. Patent 1719722. Charles F. Peterson.

MOTOR—Of the solenoid type, in which relatively high rotational speed may be obtained by either alternating or direct current, and in which the rotatable element will serve to cool the motor. Patent 1719761. Alexandre F. Godefroy.

CORD HOLDER—An attachment for electric flatirons, an element having a laterally deflected lower end with screw hole to receive one of the handle fastening screws, the upper end being bent to constitute a cord clamping member. Patent 1719766. Alfred Hopkins.

TERMINAL PROTECTOR HOOD—Which is particularly applicable to the positive terminal of a storage battery for the purpose of preventing the corrosion which usually accumulates there from spreading to other parts of the battery. Patent 1722203. William B. Day.

SLOW-ACTING CIRCUIT CONTROLLER—Capable of many uses such as delaying the extinguishing of a cellar lamp until one has ascended the stairway, or allowing one to retire to bed before the lamp illumination is extinguished. Patent 1720896. Frank W. Haderman.

Of Interest to Farmers

POWER-DRIVEN CORN-CUTTING ATTACHMENT FOR BINDERS—Which may be quickly and easily attached to and detached from the tractor by which it is driven, the connection being flexible eliminating undue strain upon the parts as it passes over the field. Patent 1719033. Lars G. Viking.

TRACTION PLOW—Whereby adjustment may be made for obtaining desired depth of furrows, compensating for irregularities of surface, for moving the plows into and out of contact with the soil, and for entirely releasing the implement when encountering obstructions. Patent 1720608. Fred W. Reimold.

REVERSIBLE PLOW—Which is adapted to be secured to the draw-bar of a tractor, will make a relatively wide cut, and is constructed with means for regulating the angle of inclination and controlling the depth of cut. Patent 1721456. Garnett O. Lee.

CONTAINER—Adapted for shipping apples, fruit or vegetables, including a pair of tub-shaped sections, equivalent to baskets, which may be easily filled, secured together, end to end, and shipped as a barrel, and returned as nested baskets when empty. Patent 1721448. Foster J. Heacock.

Of General Interest

EGG BEATER—Which is portable, and may be held in one hand while being operated by the other, and in which the egg is entirely enclosed during the beating operation, in a spherical container. Patent 1719973. Thomas L. Frates.

NAPKIN DISPENSER—A metal casing wherein folded paper napkins are properly held in position so that when a napkin is removed by grasping one of the edges and then pulling, the next napkin will automatically take its place. Patent 1719690. Charles H. Coons.

COCKTAIL-SHAKER TOP—A cap which will function as a stopper for beverage shakers, wherein oppositely extending spouts are provided with a strainer connected therewith to prevent ice and other material from moving out with the liquid. Patent 1719688. William F. Bruning.

applied to them. It was suggested by the Commissioner that registration would not be denied if the applicant sold the material to be afterward applied to the scale and scale parts.

It is specified in the trademark statute, Section 1 of the Act of February 20, 1905, that the owner of a trademark may obtain registration by complying with certain requirements, among which are the following: "The class of merchandise and the particular description of goods comprised in such class to which the trademark is appropriated." The decision held that the applicant had not complied with this specification of the statute, and therefore had not shown trademark use.

Photoelectric Comparator

ALTHOUGH the claim was rejected for a method of measuring the speed of a rotating body, patent was allowed on another claim covering a method of comparing the speed of one rotating body with that of another, in a recent decision of the Board of Appeals. The decision was made in recognition of the advantages in convenience and the saving of time with such an arrangement, particularly in its application in an electric system for simultaneously comparing a watt-hour meter with a standard meter.

Speeds of movement of two rotating devices are compared by "photoelectrically generating current impulses having frequencies proportional to the respective rates of movements of said devices, converting said impulses into alternating currents and comparing the frequencies of said alternating currents by measurement on a common scale."

War Claims Arbiter Announces Liberal Policy

COMPENSATION for alien patents appropriated or licensed by the United States government during the World War will be allowed in the approximate amount that probably would have been agreed upon in fair negotiation between an American citizen and his government. In announcing this policy, the War Claims Arbiter, Judge Edwin B. Parker, has reserved the right to determine the weight of evidence in all cases coming under his jurisdiction.

While both the value to the owner and to the government will be considered in each case, neither value will decide the fixing of compensation to be awarded, according to the Arbiter. Approximately 70 cases involving alien claims to patents were disposed of in an order made public July 18, dismissing or otherwise acting on motions, cases, and stipulations of counsel growing out of seizures and alleged seizures by the Federal government, or other activities on which claims were based.

Under the Settlement of War Claims Act of 1928, a claimant is entitled to some compensation for the license which the government took and held. Compensation implies that the license has some value, and the fact that the government as a willing buyer wanted the license, took it and held it, implies that it has some value, however small. Under the Act of 1928, the Custodian has returned claimant's patents to them, subject to the government's license, thus in effect reasserting the government's rights under the license.

SAFETY RAZOR—Especially designed for use in connection with blades of the double-edge flexible type, for preventing angular displacement of the blade, and for insuring the proper registration of the edges with the teeth of the guard. Patent 1719670. John F. O'Malley.

LAMP-SHADE-FRAME CENTER ELEMENT—Which may be spun or stamped from sheet material to provide a hub and outwardly projecting sections, and to become substantially an integral part of a lamp shade frame without resorting to welding or soldering. Patent 17345 (Reissue). Kornel C. Berger.

PENCIL SHARPENER—Comprising a block of rectangular form capable of utilizing safety razor blades for sharpening pencils by a trimming of the wood in such manner as to reduce to a minimum the danger of breaking the lead. Patent 1719714. Jerome J. Miller.

FURNITURE CONSTRUCTION—In which red cedar may be used as a core for veneered furniture, such as clothes chests or the like, the formation of the cedar being such that the greatest amount of oil fumes will pass therefrom. Patent 1718585. Edward Roos.

EDUCATIONAL ASTRONOMICAL DEVICE—Including physical embodiments of the sun and earth arranged in such manner as to demonstrate visually, the inter-relation of the sun and earth, particularly with respect to the seasons of the year. Patent 1719723. David Phillips.

INSERT FOR CASTINGS—By which two members may be joined without drilling into or through either for the reception of a bolt, the bolt being mounted inside, and not visible from the outside, or marring the outer appearance. Patent 1719739. Lafayette H. Caldwell.

SAFETY RAZOR—The handle of which has a flexible section produced by a coil spring, the blade holder being so constructed as to permit of the ready insertion and removal of blades. Patent 1719675. Charles T. Sirch.

EQUALIZING DEVICE FOR EXTENSION TABLES—The racks being so arranged as to preclude all possibilities of disengagement of the pinions, thus maintaining the extended portions at equal distance from the central support, thereby properly distributing the weight. Patent 1718635. Earl H. Cook.

FOUNTAIN PEN—Having a clip attached to the cap for engagement with a garment pocket, and for holding the cap in a vertical position with the open end upward for ready reception or removal of the nib end of the pen. Patent 1720559. William I. Light.

MATCH AND CIGARETTE HOLDER—By means of which a package of cigarettes will be securely held in connection with an ordinary match book, so that the two may be at all times conveniently available. Patent 1720589. Solomon Danab.

SQUEEGEE—Or scraper, having a body and handle receiving socket, wherein either metal or rubber blades may be used, and may be readily applied or removed at any time. Patent 1720630. William Eiermann.

SAND-BLAST CARVING AND METHOD OF MAKING THE SAME—For forming relief carvings of leaves, stems and berries, in which the leaf is concaved in surface contour and has sharp edges, while the stem and berry are convexed in surface contour and have smooth edges, by the use of a "coating" which resists the blast of abrasive material. The inventor has been granted three patents, 1720567, 1720568 and 1720569. George R. Philip.

LOOP CONSTRUCTION—Formed from a single strip of metal to provide integral means for attaching the same to the handle section of women's pocket-books or hand bags, to produce a slidably adjustable and ornamental handle. Patent 1720617. Charles Wolf.

BOTTLE CARRIER—Including a hand grip and a pair of pivotally mounted spring pressed members to be forced over the top of the bottle and automatically grip the same, particularly adapted for conveying milk bottles. Patent 1720500. Harold E. Watrous.

Thermostatic Air Control—Adapted to be disposed at any point in a room for automatically controlling the flow of air or other fluid to regulate the opening and closing of radiator valves, thus regulating the temperature of the room. Patent 1720572. Alexander A. Riccio.

Fruit Masher and Strainer—Comprising a container having a closure at the top, and a strainer intermediate its ends, a beater rotatably mounted for crushing the fruit and impressing the juice, and means for discarding the skins and seeds. Patent 1721340. Fannie Giboney.

Store System—Wherein a portable receptacle is successively moved to a plurality of attendants, who place the ordered merchandise into the receptacle from bins or shelves arranged along the path of the receptacle. Patent 1720917. Melville M. Moore.

Stretcher—An adjustable rectangular frame and a pair of rollers on which lace or heavy curtains, or articles such as blankets, may be stretched for drying after washing, the device is particularly adapted for blankets. Patent 1722217. Alfred Hopkins.

Cup Vase and Spray Holder—A simple construction formed by the association of a water receiving element, and wires, for holding flowers in summer or a spray of holly in winter on a grave, adapted to be driven into the ground. Patent 1722197. William H. Carnoe.

Carpet Beater—Constructed of several lengths of wire which are interengaged and twisted to provide a blade, the free ends being interlocked to afford a shank for the reception of the handle. Patent 1722162. Harold F. Teetsell.

Gas-Meter Fitting—Designed to prevent leakage at the meter, due to the loosening up of joints and connections due to vibrations either within the house, or caused by the passing of heavy traffic. Patent 1722236. Adolph Sconeberger.

Display Device—Affording means for displaying various articles, such as postage stamps, butterflies, and other articles, at the same time affording the maximum visibility and protection against contact with other objects. Patent 1722223. Ernest V. Puklloc.

Sign—Having removable sign characters, and holders for suspending the characters, and a support for removable backing strips of fabric or any other flexible material to harmonize with the colors of the sign characters. Patent 1719267. Albert Holder.

Joint Cover for Pews—A metal cover strip for blind division connections so constructed that it may be assembled and held securely in place to form a blind division without the use of nails or screws on the face. Patent 1722226. John L. Kessler.

Coffee Pot—Having heat transmitting tubes so arranged as to conduct heat to the major portion of the water within the receptacle, and to prevent extinguishing a flame, in the event of the liquid boiling over. Patent 1722936. John A. Myers.

Hardware and Tools

Ophthalmic-Lens-Thickness Caliper—A gage for measuring the thickness of the center of a lens, the thickness at a radius of twenty millimeters from the center, and for determining diopters and fractions of diopters, either plus or minus. Patent 1719652. John T. Collins.

Combined Spade and Planter—A portable hand-operated tool which will easily make a hole of required depth in prepared soil, and will drop into the hole the desired number of seeds from a hopper. Patent 1720601. Godell Kalenoff.

Lock—Having a relatively massive bolt, which is substantially proof against jimmying, yet may be thrown with little manual effort by a relatively light and simple key, particularly adapted for garage door locks. Patent 1720590. Harry W. Evans.

Latch Attachment—Designed for embodiment in a latch for dumbwaiter doors, functioning in such a manner that it cannot be manipulated from within the elevator shaft, thereby becoming a burglar-proof latch and avoiding the necessity of a separate bolt. Patent 1721345. Joseph H. Levinson.

Locking Device—For locking nuts against "backing off" through vibration, but so organized as to permit release of the locking means and removal of the nut without injury to the nut or bolt. Patent 1722231. Early R. Penny and James W. Farrior.

Portable Power-Operating Hammer—Which is capable of being manually moved over sheet metal work, such as motor vehicle bodies and fenders, to remove from the metal undulations of any configuration to restore the metal to its original form. Patent 1718425. John R. Hilstad.

Hinge—Including a pair of plates adapted to be set into a closure and closure frame, and vested cup-shaped bearings integral with the plates defining relatively large, approximately semi-spherical bearing surfaces. Patent 1722204. Ernest Flagg.

Heating and Lighting

Heating and Ventilating Apparatus—Adapted to create a current of heated air, comparatively cool air and for controlling the flow, for use for dry rooms, offices and dwellings where different temperatures are required, for regulating fresh air and ventilating. Patent 1719659. Alfred Hopkins.

Lamp—A construction applicable to standard portable carbide lamps, as used in mines, whereby the user of the lamp may, as frequently as desired, force carbon deposit from the burner nozzle. Patent 1721422. Albert J. Utz.

Heat Control for Gas Cookstoves—For modifying the effective cooking temperature after the material being cooked has been thermostatically acted upon for a selected predetermined period of time. Patent 1719991. John F. Newsom.

Machines and Mechanical Devices

Grinding Machine—The grinding plates of which are scored, furrowed or serrated, thereby setting up an epicycloidal grinding action which imparts a peculiar mulling or rubbing and thoroughly reduces the material fed between the plates. Patent 1719784. Mortimer G. Ross.

Liquid-Measuring-Dispensing Tank—Embodying a plurality of compartments graduated in size and of varying capacity and arranged to dispense the contents of any one or more of the compartments at the will of the operator. Patent 1719748. Arthur R. Bateman.

Coupling Connection for Pump Rods—A simple, reliable and quickly adjustable means, for connecting the upper end portion of a pump rod or sucker so that the rod length can be varied releasably to the vertically reciprocating part of the pumping jack. Patent 1719664. Arthur L. Ligon.

Dishwashing, Sterilizing, and Drying Machine—Comprising dish-holding baskets which move along rails in a rectilinear tunnel under the successive action of jets of washing and rinsing waters, and currents of drying air, supplied by centrifugal pumps. Patent 1720622. Jules L. Breton.

Towel Cabinet—A mechanism in which a continuous strip of towel is fed and at each movement different advertising matter displayed, the dirty towel being returned to the cabinet for convenient removal when strip is exhausted. Patent 1720218. Albert L. Jones and Henry C. Ruschmeyer.

Mold for Casting Stereotype Plates—Having an insulating layer of paper, or the like, on the core, one end of the insulating sheet being clasped by a spring, the other wound around a spindle, that it may be stretched smooth by a hand-wheel. Patent 1720585. Carl Winkler.

Packing—In which the necessity of constantly adjusting the packing nuts and glands is obviated and yet a proper effective and uniform packing is maintained, particularly designed for use in connection with engine pumps and compressors. Patent 1720563. Clarence A. Neal.

Gearing for Revolving Spindles—The teeth of the worm wheel being broad so that when worn it may be moved on the shaft, and fixed in a new position for driving the spindle, thus increasing the life of the gearing. Patent 1721433. John Degerth.

Process for Felting Woolen and Like Textile Fabrics Having Wool Powder Incorporated Therewith—By mechanism which causes a repeated circulation of the fabric through a soap bath, containing wool powder in suspension, and incorporating said powder by means of pressure. Patent 1721470. Etienne Ricalens.

Anchoring Device—Comprising the combination of rigid plates having rows of holes for the insertion of stakes which are driven into the ground to form an anchorage for heavy horizontal traction in operations performed by winches. Patent 1721436. Jean Dubois and Bernard Plantade.

Phonograph Arm—So constructed that the maximum output of the needle vibrations will be transmitted into sound waves and incur minimum loss by absorption in the mechanical parts of the apparatus. Patent 1721362. Robert S. Weir.

Flush Valve—Which eliminates the use of the diaphragm, and substitutes a metal wall capable of resisting the attacks of foreign matter forced against it by water pressure, particularly adapted for use in marine work. Patent 1722155. Claus D. Myer.

Method of Removing Sediment from the Tanks of Oil-Burning Ships and Tankers—Whereby the sediment may be liquefied by the use of a solvent and the addition of hot water and steam, then pumping the liquefied sludge exteriorly of the ship. Patent 1722211. Stephen Guardino.

Flush Tank—Having a removable guide so formed as to guide the flush valve directly to its seat, a stop means preventing unnecessary movement, and a float valve for preventing overflow. Patent 1722200. Thomas H. Chadwick.

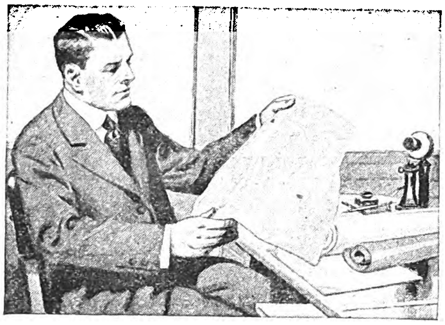
Pulp Screen—For handling a wide variety of pulp, such as ground wood pulp, sulphide pulp, soda pulp, sulphate pulp, defibered waste paper, subjecting the stock to a thorough washing, and retaining only the best quality of paper-making fibre. Patent 1722874. Harold D. Wells.

Liquid Dispenser—Particularly adapted for use in connection with road machines, such as rollers, in which it is desired to apply to the surface of the roller a liquid which will prevent sticking of the roller to road surfaces. Patent 1722907. James Liddle.

Medical and Surgical Devices

Bed—Which is convertible, having substantially the appearance of an ordinary sleeping bed, but having removable parts with substitutions therefor, readily adapted for use as an obstetrical delivery bed, with means for greatly assisting nature, and the attendant. Patent 1719677. Robert C. Sutton.

Denture-Attaching Device—Wherein removable spring means are presented engaging oppositely facing side walls, for resiliently yet firmly clamping interlocking parts to resist accidental removal, yet permit of easy removal when desired. Patent 1720587. Jacob and Simon Arkus.



Mechanical Engineering

Learn at Home

Mechanical Engineering embraces the design, construction and operation of machines and machine tools. It is a profession which offers almost unlimited opportunities to men who combine natural mechanical ability with technical training.

For this is The Age of Machinery. Almost every convenience, luxury or necessity which we enjoy depends on machinery for its production or adaptability to our needs. Every new invention multiplies the opportunities for competent designers, builders, erecting engineers, etc.

One of the best ways to train yourself to secure a position as a Mechanical Engineer is through the home-study courses of the International Correspondence Schools.

These courses are complete and up-to-date, and they are especially arranged to meet the needs of the student who studies at home.

They are particularly helpful because they are written by well-known mechanical engineers who have had years of practical experience in this field and who know the quickest, best way to solve every problem.

Just mark and mail the coupon and we'll gladly send you Free Booklets describing the I. C. S. courses in Mechanical Engineering or any other course in which you are interested.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 6111-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, "Who Wins and Why," and tell me how I can qualify for the position, or in the subject, *before* which I have marked an X:

☐ **Mechanical Engineering**
☐ **Mechanical Course**
☐ **Drafting**
☐ **Mechanical Drawing**
☐ **Complete Shop Practice**
☐ Architect
☐ Architectural Draftsman
☐ Building Foreman
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Electrical Engineer
☐ Electrical Contractor
☐ Electrical Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Telegraph Engineering
☐ Telephone Work
☐ Civil Engineer
☐ Surveying and Mapping
☐ Bridge Engineer
☐ Gas Engine Operating
☐ Automobile Work
☐ Airplane Engines
☐ **Toolmaking**
☐ **Blacksmithing and Forging**
☐ **Patternmaking**
☐ **Foundrywork**
☐ **Machine Shop Practice**
☐ Plumber and Steam Fitter
☐ Plumbing Inspector
☐ Foreman Plumber
☐ Heating and Ventilation
☐ Sheet-Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration Engineer
☐ R. R. Positions
☐ Highway Engineer
☐ Chemistry ☐ Pharmacy
☐ Mining Engineer
☐ Navigation ☐ Assayer
☐ Iron and Steel Worker
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Agriculture ☐ Fruit Growing
☐ Poultry Farming
☐ Mathematics ☐ Radio

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C. P. A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Common School Subjects
☐ High School Subjects
☐ Illustrating
☐ Cartooning

Name..
Street Address..
City.............................. State..............................
Occupation..

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—OCTOBER, 1929

Allied Radio Corporation ... 358
American Lead Pencil Co ... 359
American Pipe Bending Machine Co ... 359

Francis Bannerman Sons ... 360
Bartlett-Hayward Company ... 351
Bernard & Heller ... 361
Charles Bond Company ... 360
Broderick & Bascom Rope Company ... 355

Chicago School of Watchmaking ... 360
Chicago Stock Gear Works ... 360
Chicago Technical College ... 360
Columbia University ... 349
Crescent Tool Company ... 361

Dodge Brothers Trucks ... Second Cover

Elec. Service & Eng. Bureau (P.O. Box 132) ... 360
Encyclopaedia Britannica, Inc ... 275

Florsheim Shoe Company ... 357
Ford Motor Company (Aviation) ... 280

Gillette Safety Razor Company ... 276

Hamley & Company ... 361
Harper & Brothers ... 347
J. J. Heinrich ... 361

International Correspondence Schools ... 368
International Typewriter Exchange ... 359

Keasbey & Mattison ... 358

La Salle Extension University ... 361
Los Angeles Chamber of Commerce ... 278

Masonite Corporation ... 339
Matthews Company ... 358
Metal Cast Products Company ... 360
Metallic Sign Company ... 360
Milwaukee Die Casting Company ... 353
Wm. Mogey & Sons, Inc ... 360
Munn & Co ... 358 & 361

National Automotive School ... 360
National Electrical School ... 360
N. Y. Electrical School ... 356

Packard Motor Car Company ... Third Cover

R. J. Reynolds Tobacco Company ... Fourth Cover
Roat & Lohman ... 359 & 361

A. Salvaggio ... 361
Schwerdtle Stamp Company ... 360
Science News-Letter ... 359
Charles A. Scott ... 361
Signal Electric Mfg. Company ... 359
S K F Industries, Inc ... 273
Speednut Wrench Corporation ... 360
Stephenson Laboratory ... 360

Timken Roller Bearing Company ... 341
Treasure Sales Company ... 358

Unisol Mfg. Company ... 360
United Enterprises, Inc ... 360

Veeder-Root, Inc ... 357
A von Schon ... 360

Western Electric Company ... 345
Westinghouse Electric & Mfg. Company ... 343
Wollensak Optical Company ... 359

Henry Zuhr, Inc ... 361

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor
ALBERT A. HOPKINS
A. P. PECK
ALBERT G. INGALLS
F. D. MCHUGH
LOUIS S. TREADWELL
HENRY W. HOUGH
PROFESSOR HENRY NORRIS RUSSELL
PROFESSOR ALEXANDER KLEMIN

CORRESPONDING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

WALDEMAR KAEMPFFERT, Director Rosenwald Industrial Museum, Chicago.

M. LUCKIESH, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.

W. D. PULESTON, Captain, United States Navy—Technical Adviser on Military Matters.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 4. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

05 6-ngng
SA

INDUSTRIAL NUMBER

Henry Ford Talks of Edison — Research and Finance

SCIENTIFIC AMERICAN

November 1929

35¢ a Copy

Howard Brown

THE LIBRARY OF THE
OCT 12 19
UNIVERSITY OF ILLINOIS

Power From the Earth

CARS THAT STAY YOUNG

TIMKEN BEARING EQUIPPED

CROSSES INDICATE
"TIMKEN BEARING EQUIPPED" POINTS

MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	Steering	Differential
Auburn.........	All	.x.	.x.	.x.	...	.x.
Cadillac........	All	...	...	...	...	.x.
Chrysler.......	De Soto	.x.	.x.	.x.	...	.x.
	Plymouth	.x.	.x.	.x.	...	.x.
	66, 70, 77	.x.	.x.	.x.	...	.x.
	Imperial	.x.	...	...	...	.x.
Cord	All	.x.	.x.	.x.	.x.	.x.
Cunningham....	All	.x.	.x.	.x.	...	.x.
Dodge..........	All	.x.	.x.	...	...	.x.
Durant.........	40, 60, 63, 66	.x.	.x.	.x.	...	...
	70	.x.	.x.	.x.	...	.x.
Elcar...........	75	.x.	.x.	.x.	...	.x.
	95, 96, 120	.x.	.x.	...	...	.x.
Ford...........	All	.x.	...	.x.	.x.	.x.
Franklin........	All	.x.	.x.	.x.	.x.	.x.
Gardner........	All	.x.	.x.	.x.	...	.x.
Graham-Paige...	612	.x.	.x.	.x.	.x.	.x.
	615	.x.	.x.	...	...	.x.
	621, 827, 837	.x.	.x.	...	.x.	.x.
Henney........	All	.x.	.x.	.x.	...	.x.
Hudson and Essex	All	.x.	.x.	.x.	...	.x.
Hupmobile......	Model S	.x.	.x.	.x.	.x.	.x.
	Model M	.x.	.x.	.x.	.x.	.x.
Jordan..........	All	.x.	.x.	.x.	...	.x.
Kissel..........	75 & 95	.x.	.x.	.x.	...	.x.
	126	.x.	.x.	.x.	.x.	.x.
Kleiber.........		.x.	.x.	.x.	...	.x.
LaSalle.........	All	...	...	...	...	.x.
Lincoln.........	All	.x.	.x.	.x.	.x.	.x.
Locomobile......	86 & 88	.x.	.x.	...	...	.x.
Marmon........	68	.x.	...	...	...	.x.
	78	...	.x.	...	...	.x.
	Roosevelt	.x.	.x.	.x.	...	.x.
McFarlan.......	All	.x.	.x.	.x.	...	.x.
Moon...........	All	.x.	.x.	.x.	...	.x.
Nash...........	Std 6	.x.	.x.	.x.	...	.x.
———..........	All	.x.	.x.	...	.x.	.x.
Peerless.........	All	.x.	.x.	.x.	...	.x.
Pierce-Arrow....	All	.x.	.x.	.x.	.x.	.x.
Reo Flying Cloud	The Master	.x.	.x.	...	.x.	.x.
	Flying Cloud	.x.	.x.	...	...	.x.
Roamer.........		.x.	.x.	.x.	...	.x.
Stearns-Knight..	6-80	.x.	.x.	.x.	.x.	.x.
	8-90	.x.	.x.	.x.	.x.	.x.
Studebaker and Erskine...	All	.x.	.x.	.x.	.x.	.x.
Stutz...........	All	.x.	.x.	.x.	...	.x.
Willys-Knight and Whippet..	All	.x.	.x.	.x.	.x.	.x.

WINGS . . . *Motor*-wings

. . . away with the wind . . . distance blurring into background . . . miles flying past . . .

But cars "Timken Bearing Equipped" scarcely mark the miles passed . . . there is before them a future filled with youth and use.

Those speed demons — shock, thrust and torque — meet their match and master in Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel — exclusive guardians of car youth.

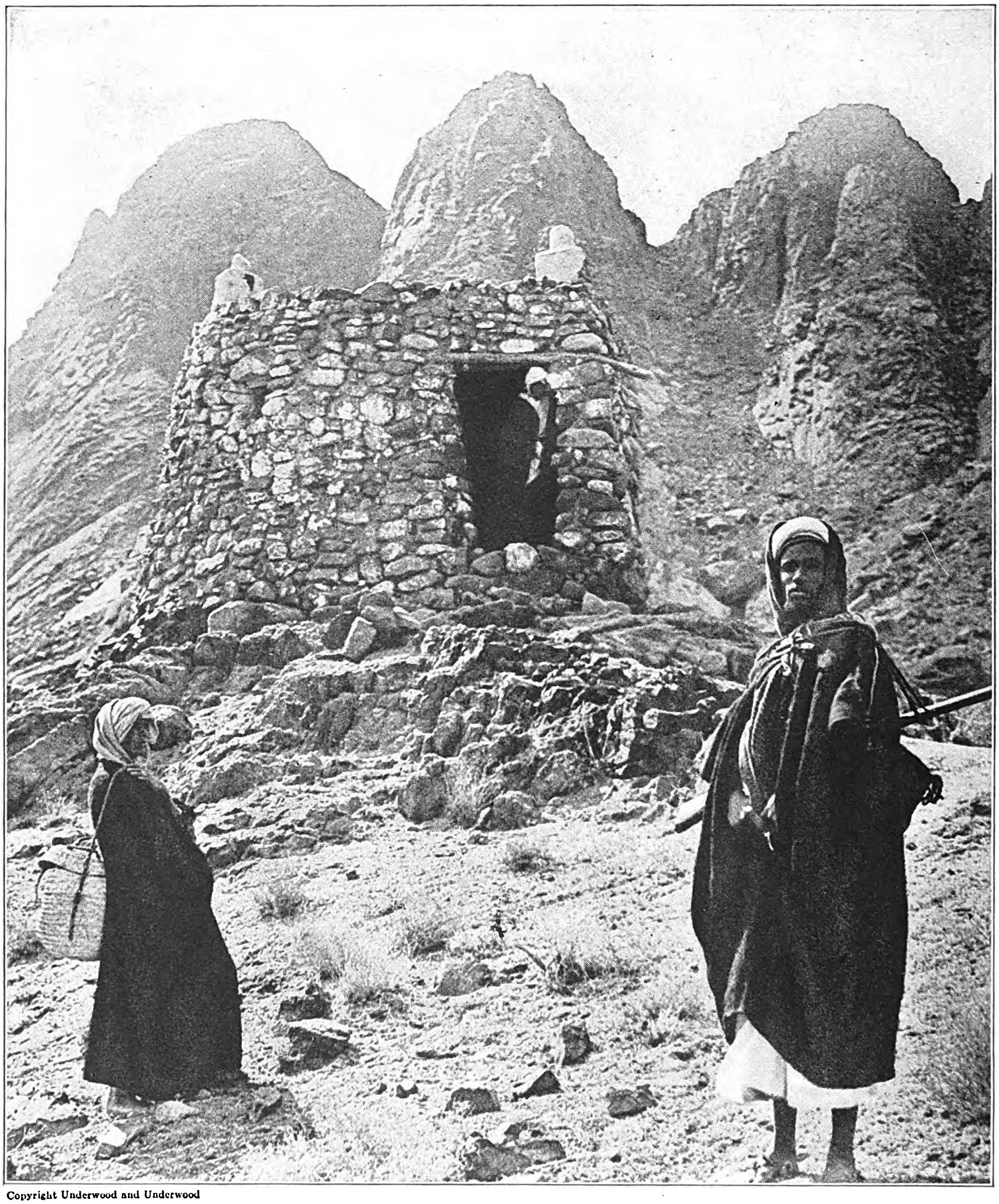
Motorists who want pedigreed performance consult the list of cars "Timken Bearing Equipped" and use it as their guide to Cars That Stay Young.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN ***Tapered Roller***
BEARINGS

George Eastman

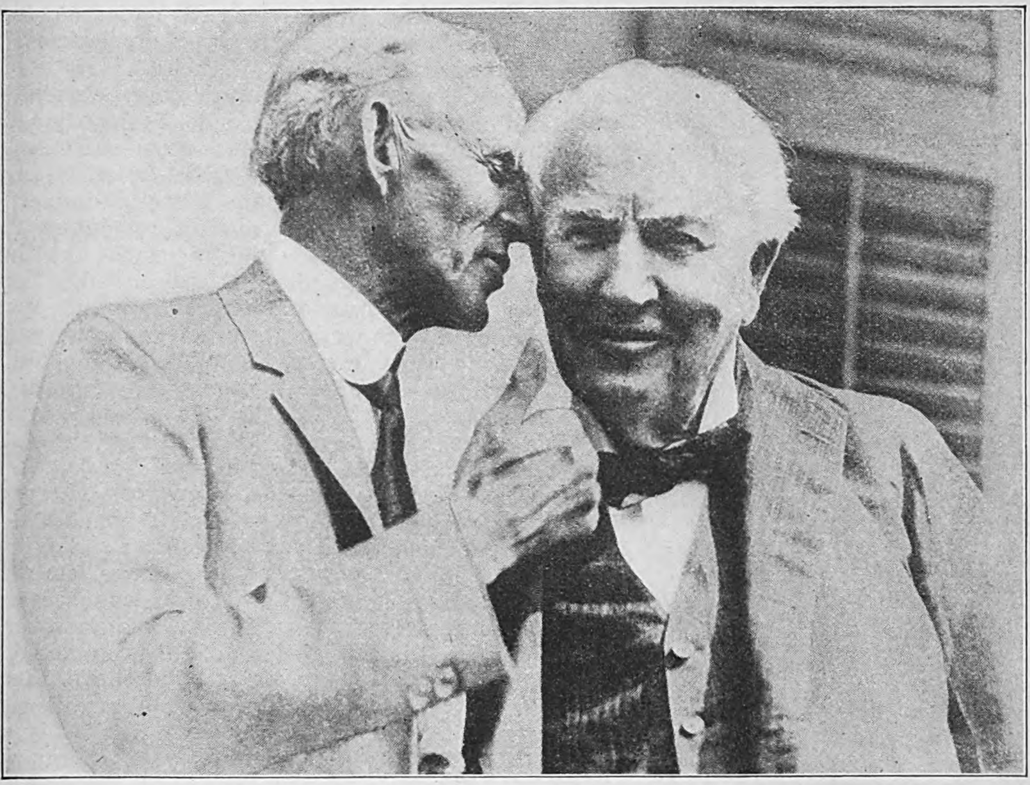
WHEREVER you travel throughout the world, whether it be to Paris, Berlin, Karnak on the Nile, Tahiti, the jungles, or even the forbidden city of Lhasa—wherever science, adventure, or romance calls—there you will find in use Kodaks from the factories of George Eastman. Back in the days when photography was a slow process and the equipment was ponderous, Mr. Eastman began experimenting in the new art. In 1880 he began manufacturing dry plates in a small way and soon afterwards invented the Kodak. He is now Chairman of the Board of The Eastman Kodak Companies of New York and New Jersey. At the age of 75, he is a leader in business and philanthropic enterprises, and is an enthusiastic big game hunter.



Copyright Underwood and Underwood

Sinai, the Sublime Triple-headed Mountain

THERE has been considerable controversy as to whether the "sublime triple-headed mountain" which for centuries has borne the name of "Sinai," called in the Bible "Horeb," that is, "the desolate," was the scene of God's proclamation of His Law to the Children of Israel. The evidence of geology, history, and archeology, seem to favor it, and no other spot can advance a claim to compare with this wondrous site. The Sinai Peninsula lies between the Gulf of Suez and the Gulf of Akabah and juts into the Red Sea. It is an extremely difficult spot to reach. The triangular-shaped region is as large as Sicily and is a rocky country with huge ranges of primeval gneiss and granite. The tallest of the peaks is 6712 feet high. The Book of Exodus gives us a full account of the wanderings of the Children of Israel, their flight from Egypt, the crossing of the Red Sea, the journey to Sinai, the appearance of the Lord on Sinai, and Moses receiving the tables of the law. The native inhabitants are Bedouins and are not as blood-thirsty as they look, although our views of their peacefulness have recently been shaken.



Ford's Friend Edison

Mr. Ford Talks of Mr. Edison, of Industry, of Youth, and of the Inspiration of Edison's Achievements Which He Is Commemorating at Dearborn

By F. D. McHUGH
Associate Editor

"MR. EDISON," said Mr. Ford, as he lounged, rather uncomfortably it seemed, in a straight-back chair in his office at Dearborn, a thoughtful smile puckering the corners of his steel-gray eyes, "by his invention of the incandescent light contributed more to the progress of the world and the comfort of his fellow beings than any other man. By this invention alone, he freed man from the one thing that retarded, perhaps more than any other, his rapid industrial development—Mr. Edison freed man from darkness, lengthened his day so that he could increase his production and his producing efficiency.

"Mr. Edison gave light to the world on October 21, 1879, when he perfected an incandescent lamp at his Menlo Park, New Jersey, laboratories. It was more than a mere convenience; it was, together with his development of the dynamo, the beginning of the great industrial activity and the hitherto undreamed-of prosperity of today. The perfected Edison dynamo liberated industry from dependence on the line shaft and leather belt; it made the modern factory and our great production facilities possible. Mr. Edison, as a contributor to human welfare, is a man whose work and achievements should be an inspiration to all young men. I do not mean, of course, that every growing boy should set his mind toward becoming a scientist or an inventor, but that he should take example and inspiration from the leadership and energy and usefulness of Mr. Edison.

"LEADERS are needed now more than ever before; leadership is the only thing in which there is now a shortage. Industry has developed into a tremendous complex thing and it is not as easy as in the old days to find enough men with intelligence, ambition, and the capacity for hard work. It has been said that this is the day of the young man. To some extent that is true and I admire those young men who have achieved something. As a rule, however, they are not successful in proportion to the opportunities they have and the modern facilities at hand.

"The youth of today is too superficial. He should broaden his outlook and become interested in a wide range of subjects. It is not enough that he specialize, for even specialization requires a vast general knowledge. No knowledge comes amiss. The boy who disregards any chance to learn something because it may not seem to be in his line, is injuring himself. The specialist today requires a knowledge of things in many fields, some of which may appear wholly unrelated to the end in view. That is why I approve of Mr. Edison's efforts to select young men for training in leadership. It is a start in the right direction. Anything that will impress young men with the importance of knowing the 'why' and the 'how' of things, is worth trying. Whatever the critics may say of the questionnaire method, it has one undeniable merit—it shows how much and what kind of work the boy has done. I hope other men will follow Mr. Edison's excellent example and take up the task of finding the raw material of leadership."

Let it be understood that Mr. Ford is no orator. His remarks, as quoted above, were brought out by a series of questions which I had addressed to

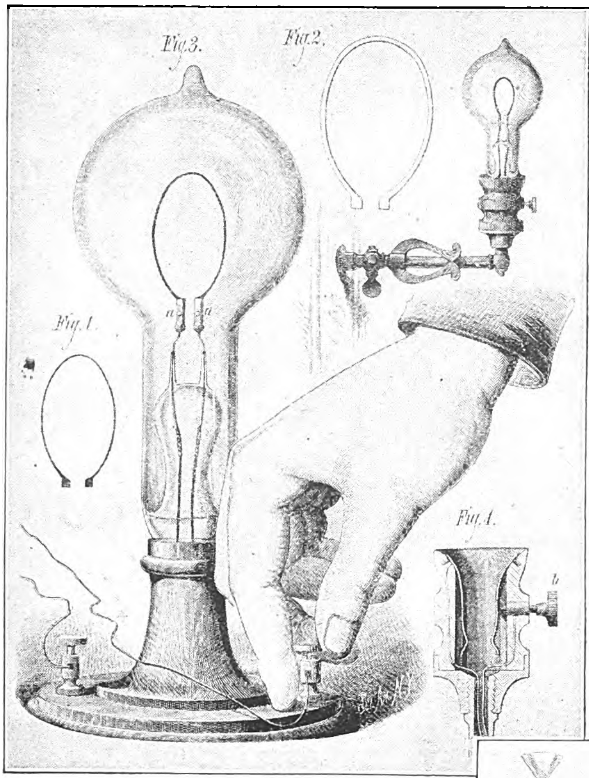
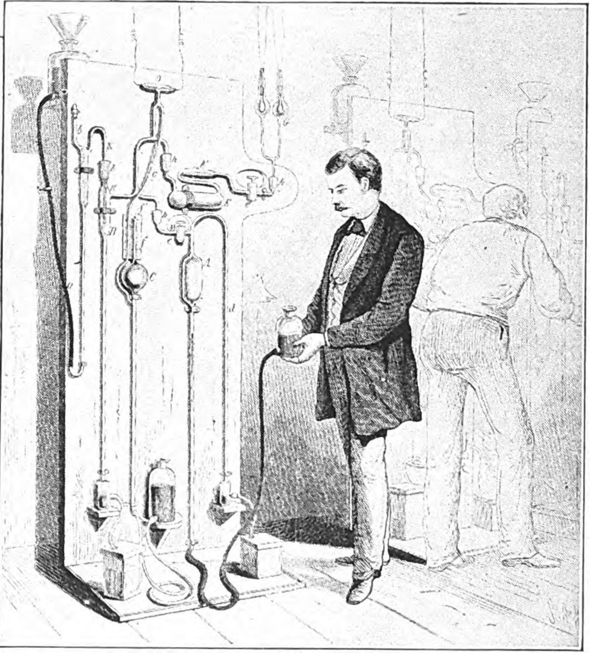


Fig. 3.
Fig. 2.
Fig. 1.
Fig. 4.



EDISON'S LAMP; EVACUATING IT

Reproductions of two woodcut illustrations from SCIENTIFIC AMERICAN, January 1880. The upper one shows a very early type of Edison carbon lamp and its various elements including: Figure 1, the completed carbon "horseshoe" filament and, Figure 2, the paper blank for the filament. *Below*, the method of evacuating lamps

him with the specific purpose of learning as much as possible concerning his personal feelings toward his friend Thomas A. Edison, apropos the 50th anniversary of Edison's invention of the incandescent light, the celebration this year of that occasion by "Light's Golden Jubilee," and certain activities of Mr. Ford relative to this anniversary, which will be discussed later. Mr. Ford, however, obviously prefers not to touch upon the personal side of his friendship for Mr. Edison. Whether this be from a sense of delicacy—which would seem quite natural under the circumstances—or for some other reason, is not known. It is certain, however, that a very deep friendship binds Edison and Ford, a friendship which, on Ford's side, has the qualities of reverence and hero-worship in it.

"How long have you known Mr. Edison?" I asked.

"Thirty-two years," Mr. Ford answered. "No; in seven days—let me see a calendar—in five days, yes, in five days it will be thirty-three years." He said this with the hint of a happy smile playing about his eyes. It was evident from the answer and the manner in which he gave it that this particular date is deeply engraved upon his memory and is a very important one to him.

As a matter of simple fact, it was a very important date, not only to Mr. Ford but to the world in general. The occasion of the meeting was a convention of engineers which was attended by Mr. Edison, then already famous for many great inventions, and by Mr. Ford. Mr. Ford was at the time employed as chief operating engineer by the Detroit Edison Company. He had just built his first "horseless carriage" and was already at work on his second, and as yet he had not had a single word of encouragement from any human being—least of all from any one skilled in mechanics. Dining at the same table, the world-famous "electrical wizard" and the obscure engineer, later to become the world's greatest industrial genius, were introduced. Mr. Edison, impressed with Mr. Ford's ideas no less than with his sagacity and perseverance, did not mince words in letting Mr. Ford understand his belief in the principle of the new motor car. Having received this encouragement from so great a man, the first real encouragement he ever received, Mr. Ford went home as fast as he could and hastened the work of finishing his second car.

"How long was it after your first car was built, Mr. Ford," I asked, "that you met Mr. Edison?"

"Three years," was his reply.

"You had previously considered him as a man to be looked up to, a man who had set an ideal of achievement, a sort of inventive wizard, had you not?"

"I admired him, yes," he said slowly, and then evaded any personal allusion to his friend by turning to a single point of my question. "Most people," he said, "call Mr. Edison the 'electrical wizard' and seem to think that he is more of an electrical genius than anything else. He is all of that and more—much more; he's a many-sided man who has done many remarkable things outside of electricity. He has revolutionized American life and made possible American industry. What man in history has put so visible and enduring a mark on the world as has Mr. Edison? By the way, one of my earliest introductions to Mr. Edison's work was in the pages of SCIENTIFIC AMERICAN. I could show you some pretty old copies of your paper.

"It was not so much what he did as what he was that first gripped me—his power to work. When Mr. Edison started work on a problem, he studied everything that had been done on it previously; then, instead of starting where others left off, he worked out the problem according to his own ideas. And he never stopped until he had fully completed the job."

"You believe, then, in profiting by the mistakes others make?" I asked.

"Only as they affect the general theory behind the problem," he answered. "No man can duplicate the work of another. If he attempts it, the result will be failure. If he begins on an original design and if that design is practical and he works hard enough, success will come regardless of the mistakes or successes of others."

Mr. Ford's favorite form of statement is axiomatic. He takes a keen delight in following every turn of a conversation and in discussing whatever may be suggested by something that has been said. He is not dogmatic in giving his opinions but he states them in a manner so clear and concise that there is no mistaking his meaning.

When an attempt was made to get Mr. Ford to talk of the vacations he has spent with his three closest friends, Mr. Edison, Harvey Firestone, and the late Luther Burbank, he was reticent. His answer to a question indicated that he did not wish to be quoted on that subject, so the conversation was turned to the founding of the Edison Institute and other activities of Mr. Ford.

"The Edison Institute of Technology, Mr. Ford—you've founded that as a tribute to Mr. Edison and as an expression of your friendship for him, have you not?" I asked.

"Yes," he answered non-committally, as I had feared he would.

"Then will the Menlo Park buildings which you have transplanted here in Dearborn be part of the Institute?"

"Yes. We brought the Menlo Park buildings to Dearborn to preserve them for their historical interest and to commemorate the achievements of Mr. Edison. That, however, is only part of our purpose. We expect that Menlo Park will be an inspiration to the youth of the country and especially to those who attend the Institute."

"Will your museum of Americana also be a part of the Institute?"

"Of course," he replied, and in his voice there seemed a note of impatience with those who continue to misconstrue his motive for collecting these Americana and building a great museum to house them. It is not simply a hobby as most people seem to think; it is more than a hobby—it is the preparation of a great object lesson in American progress. "In order to look forward," Mr. Ford continued, "one must be able to look backward. The historian tries to put together a true story of the past, but he is working in words and ideas that do not include the whole of history. Our museum will show in a material way the actual steps the people have made and therefore will constitute the true story of their minds."

For this museum, Mr. Ford has collected thousands of pieces illustrating many phases of industrial progress and the evolution of many objects in common use. These exhibits are now in the old tractor factory which is to be torn down, but are already catalogued and will be placed in the beautiful group of museum buildings which is now being rapidly completed.

"In a word, then, the Old Village, Menlo Park, and the museum are primarily for the instruction of students in the Institute?" I asked.

"For their inspiration," he corrected me.

In September, 1928, when the cornerstone of the still uncompleted museum building was laid, Mr. Ford, with his arm around his old friend, told Mr. Edison: "This museum and all that is connected with it is for the inspiration of youth." Mr. Edison had, during the ceremonies, made a print of his footsteps in soft concrete and then signed in it his name and the date, September 27, 1928, in large letters. The concrete in which he had embedded Luther Burbank's shovel, besides leaving his own footprints and signature—a large square block—will stand in the rotunda of the replica of Independence Hall which Mr. Ford is now building as the central part of the Administration Building of the Museum group.

"Can you recall, Mr. Ford, when you first conceived the idea of building an institute in honor of Mr. Edison?" I asked.

"No. It has been in my mind a long time and has been gradually taking shape for years."

"And I suppose you have no idea when it will be fully complete and in operation?"

"Not the slightest idea," Mr. Ford replied. "It has taken a long time to get it in its present shape and will take a much longer time to organize—properly. I expect to work on it for ten years or more. An idea of this nature cannot be worked out in a breath."

"I think I understand, Mr. Ford. You mean that nothing that is really worth while can ever be considered perfect. There is always room for improvement."

"Yes, that is it. The best evidence that a thing is basically good is that it is capable of being improved."

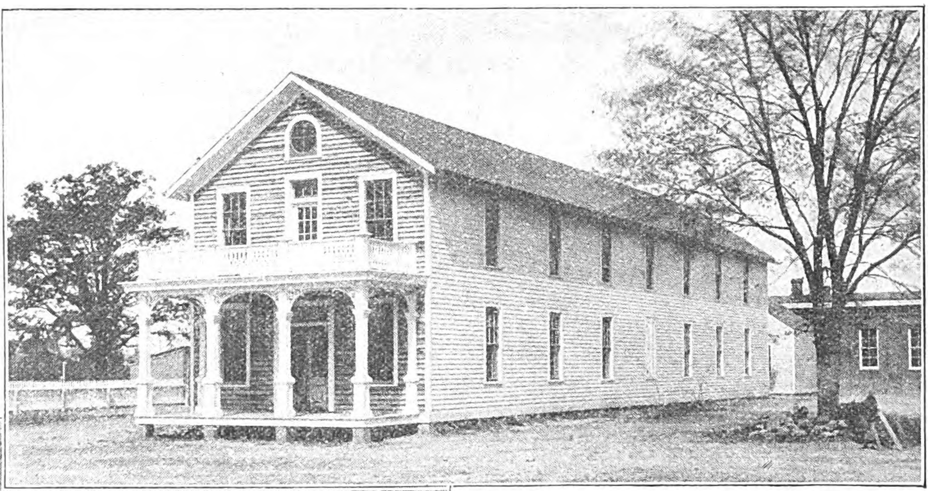
"Have you worked out a plan for the selection or appointment of students for the Institute?"

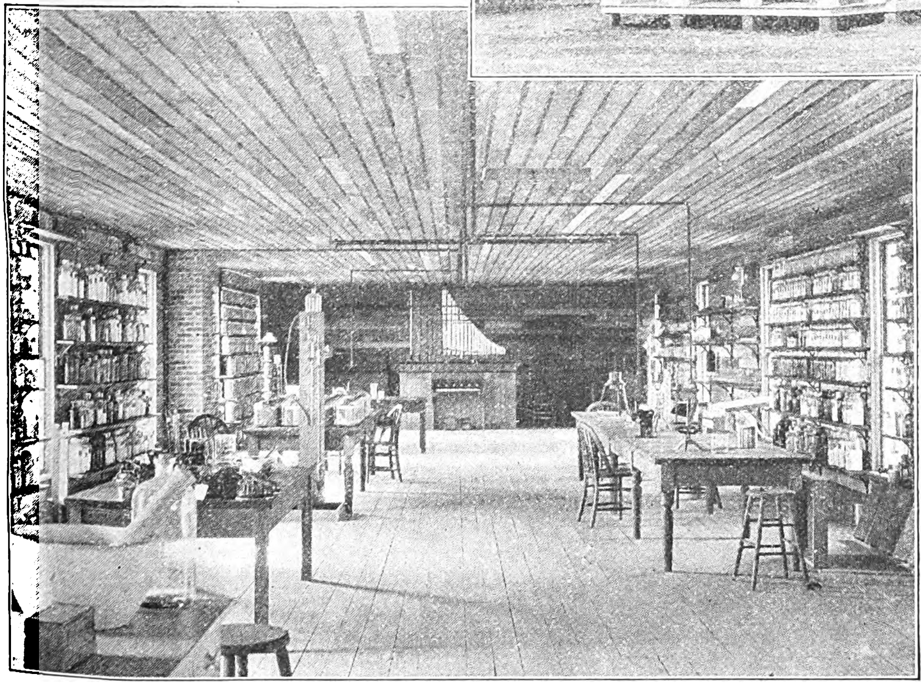
"That will all come in due time. The principal qualification, after innate ability, will be ambition and plenty of it. Students of the Institute must be of the type that will grow and do better work year after year as Mr. Edison has done. A few minutes ago I was talking with a man from Denmark who told me that in his country they have a dole system for people over 65 years of age. People of that age are given a pension by the government. Think of it! being paid to loaf during what should be a man's most fruitful years!"

"Students at the Edison Institute of Technology, then," I remarked, "should be worthy the master scientist and inventor whom their institute commemorates."

"Exactly. And if they have perseverance and stamina, I won't care whether they are mechanics or university graduates. But of course the Institute is not going to be like our Trade School. Our object in the Institute is not merely to turn out good working mechanics—what we are after is the material for leaders."

"You expect to dedicate the In-





TRANSPLANTED TO DEARBORN FROM MENLO PARK, NEW JERSEY

Edison's laboratory, interior and exterior. When Mr. Edison worked here, this laboratory was the most complete of any in private use in the world. Replica of old organ is in rear stitute on October 21 of this year, I believe?"

"Yes, the 50th anniversary of Mr. Edison's first showing of the incandescent light."

"Would you mind telling me what you have planned for the occasion?"

"The principal ceremony will be the re-enactment of Mr. Edison's first demonstration of his light invention. Mr. Edison himself will fire up his original steam boiler, start his original steam engine which will run his original dynamo and, when that is up to speed, will close a switch which will turn on a duplicate of his original light. This will be broadcast over a radio network so that lights, previously turned off all over the world, may be again turned on when Mr. Edison throws the switch."

"By 'original' boiler, engine, and dynamo, Mr. Ford, you mean the exact equipment Mr. Edison used when he first showed the incandescent lamp, do you not?"

"Yes," Mr. Ford replied.

AFTER a few minutes more of conversation on matters irrelevant to this article, Mr. Ford was called away to keep an appointment. Therefore before going on with the story, I wish to express my appreciation for Mr. Ford's friendliness during the interview which lasted about an hour, and to thank him for his expressions of his high esteem for SCIENTIFIC AMERICAN.

The machinery referred to in the last quotation is now installed in Edison's machine shop which was built in 1878 in Menlo Park, New Jersey, and recently removed by Mr. Ford to Dearborn. Other Menlo Park buildings in the group are: the original Edison laboratory which was erected in 1876; a general office building constructed the same year; a small frame structure which was used as a photographic studio and dark room but is most famous because within its walls the first incandescent lamps were blown; and Sally Jordan's boarding house. Mrs. Sarah Jordan was a widowed lady in whose house the Edison assistants lived. What is more important is the fact that her house was the first human habitation to be lighted by electric lights. Next to the boarding house stands the Fort Meyer laboratory in which Mr. Edison worked for over 40 years during his winters in Florida.

THE SALLY JORDAN BOARDING HOUSE

The house in which Edison and his assistants lived at the time the first incandescent electric light was being perfected. It was the first residence in the world to be lighted by these lamps

Around the buildings, Mr. Ford has set out trees and shrubbery to correspond as nearly as possible with the original settings. The streets, too, are laid out in proper relation to the buildings and will bear the same names. Mr. Ford has even brought several carloads of topsoil from Menlo Park, New Jersey, to be spread around the group now called Menlo Park, Michigan.

In the various buildings, Mr. Ford has installed in its proper place the equipment originally used by Mr. Edison. In the general laboratory there are, for example, great shelves of chemicals arranged as nearly as possible as Mr. Edison had them arranged while he was working there. It was not possible to obtain the full complement of chairs and tables for this building so Mr. Ford is having duplicates made to complete the furnishings. The makers of an old-time organ which stood in this room have agreed to supply a duplicate from original specifications. When Mr. Ford asked Mr. Edison to practice the old pieces he used to play on this organ, Mrs. Edison said, "Oh, he can still play Yankee Doodle."

Besides the machinery mentioned above, there are various lathes, drill presses, work benches, and so on in the machine shop. It is in this building that Mr. Edison will carry out his part of the October 21 anniversary program. Here, sitting in his old chair, at his old bench, in his own little old shop, Mr. Edison will adjust the filament in a duplicate of his original lamp, will seal the bulb, adjust it to its socket, and will then light it in the manner described by Mr. Ford in the quotation above.

In striking contrast to the Old Village, the Menlo Park buildings, and the antique and historical exhibits in these and the museum, the Ford Airport just beyond a low wire fence presents a scene of modern activity which is, in itself, a lesson in progress. Future students of the Edison Institute may thus see, side by side, the old and the new and may profit thereby.

In close perspective for all to see, the Dearborn group now presents an inspiring picture of work and achievement, of industry and progress; and he who has ambition, whether he be a student of the Institute or simply a visitor, will most surely be impressed, feel the weight of the evidence presented, and receive an impetus that should carry him far on the road to success. And, realizing the spirit that has prompted the founding of this inspirational group, he cannot fail to feel a genuine admiration for Mr. Ford's ideal.

IT will be seen that Mr. Ford has spared no effort to make Menlo Park, the Old Village, the museum, the Institute, and finally, the anniversary celebration itself as complete in every detail as is humanly possible. And it is to his credit that everything has been done according to his plans and under his personal supervision. Mr. Ford watches every brick and plank and almost every nail that goes into the buildings, and it is said that he can see a putty mark on a wall at 15 feet.

But to return to our theme; the various parts of this unique group of buildings and the ideal upon which they are being built would make a very long story and we are more interested in Mr. Edison just now. We wish we had been able to learn more of Mr. Ford's innermost feelings concerning the great scientist and inventor for it is felt that this would have provided an illuminating insight into the characters of two men who are without peers in their respective fields of endeavor. As stated above, however, Mr. Ford is reluctant to discuss the personal and intimate relationship between himself and Mr. Edison; indeed, he evades the subject altogether. Why this is so, we can only surmise, and will not hazard a guess for fear that we should probably be wrong. However, the mere fact that Mr. Ford has bestowed upon his great work at Dearborn such personal care is the surest indication of his laudable regard and admiration for his old friend Mr. Edison.

OUR POINT OF VIEW

Poisonous Refrigerator Gases

METHYL chloride, leaking from refrigerating systems, has been blamed for the recent poisoning and deaths of several persons in Chicago, and these fatalities have aroused much apprehension among users of household automatic refrigerators of all kinds.

To relieve "any undue anxiety in the minds of those possessing such systems," the United States Public Health Service, the Bureau of Standards, and the Bureau of Mines recently authorized a statement of the facts in the case. "Neither methyl chloride, ammonia, nor sulfur dioxide," the statement reads, "can be breathed with impunity but none is a violent poison when breathed a short time at low concentrations." Methyl chloride is the least poisonous of the three, but while it has only a slight and rather pleasant odor, the other two have odors strong enough for them to be immediately identified and irritating enough to make the person breathing them attempt an escape at once. Methyl chloride may not awaken a sleeping person or be recognized by one who is awake, and is therefore called the most hazardous. However, the majority of household refrigerators of the electric type use sulfur dioxide, and all of those using heat—so far as is known—use ammonia, and any leakage would be quickly noticeable by the odor.

Methyl chloride thus presents a problem which must be solved even though the danger is slight. Either refrigerating systems must be made leak-proof or a malodorous gas must be mixed with methyl chloride so that a leak will be instantly detected. Until the problem is solved, owners of automatic refrigerating systems using methyl chloride should provide good ventilation for the rooms in which their units are kept.

Jeopardizing Naval Accord

IN 1927 we sounded a warning which said in part: "Suspicion, distrust, and jealousy should never be permitted to enter the doors of a conference," and further, that "It is altogether reprehensible that the success of the naval limitation conference at Geneva should have been imperiled by the unfair, and indeed in many cases, mendacious propaganda that was carried on by the daily press before and during the meetings of that important gathering."

That statement was intended as a warning not only against the press but also against those individuals and agencies responsible for the great mass of propaganda subversive of the purpose of the conference and the best interests of the people of the nations involved. It was inspired primarily by the insidious activities of a self-styled naval expert.

The warning is as timely today as it was in 1927. As this is being written, President Hoover, with characteristic directness and honesty, has just demanded and Congress is about to begin, an investigation into the activities of W. B. Shearer at the Geneva Conference who claims that he was employed by large American shipbuilders as a "big navy" propagandist. The shipbuilders' retort is that he was employed as an "observer." Whatever the outcome of the investigation, it is obvious that much propagandizing was done and it is just as certain that it is still going on.

Our Contests

AS we go to press, the number of entries in the competition for the SCIENTIFIC AMERICAN Medal for Sea Safety totals 42, and in all probability the entries will run to 60 or over before the competition closes. Rear Admiral Winslow, the Chairman of the Committee of Judges, has issued a call for a meeting to be held on October 16th. We will announce the name of the winner and publish the successful designs at the earliest possible opportunity.

Our Light Plane Contest is officially closed with 19 designs on hand. These are now being studied carefully by the Committee of Judges, and it is expected that they will hand down their decision very shortly. The results will be given to the public as shortly thereafter as is feasible.

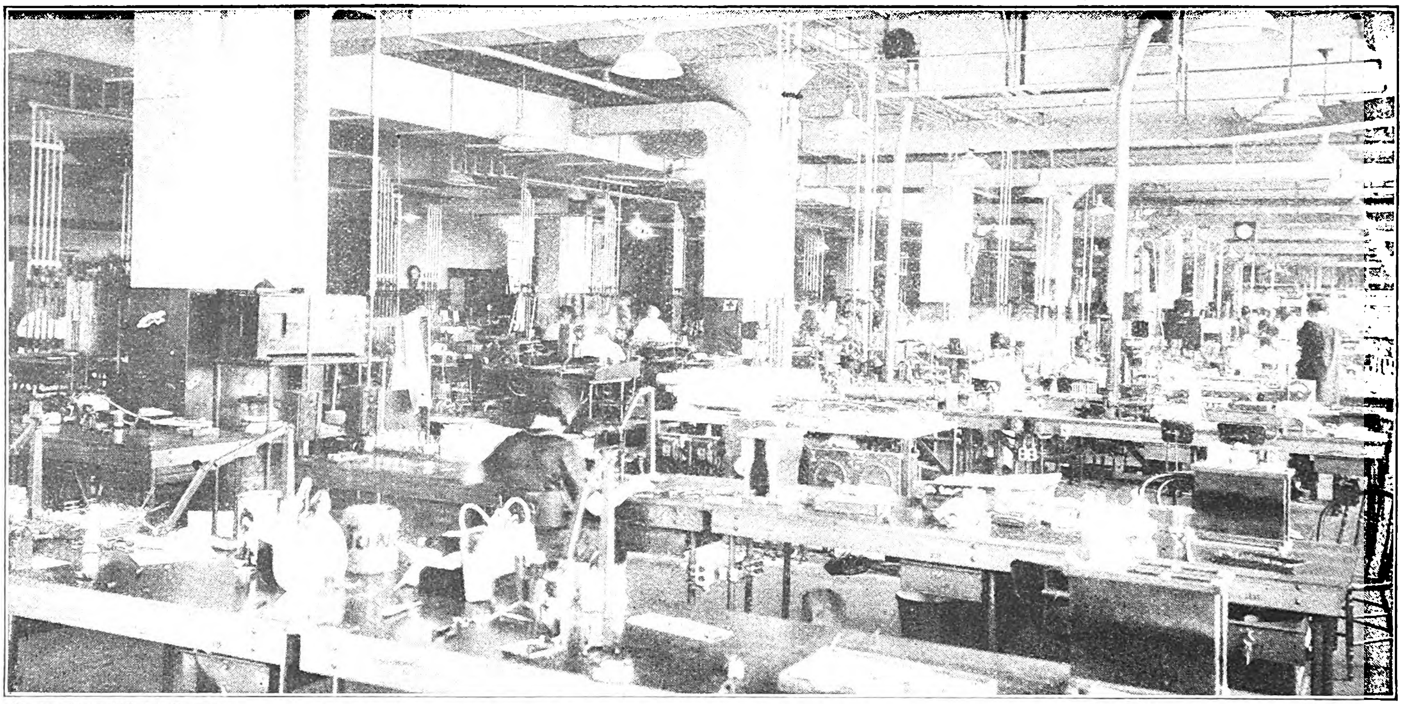
Only honesty, fairness, and good sportsmanship in this vital question will lead to the desired result and it is hoped that the President's investigation will not only put to rout the lobbyists but will also indicate to Great Britain our desire to lay all our cards on the table. It is reported that Premier MacDonald contemplates a trip to this country to talk over the matter with Mr. Hoover, but whether or not he comes to America, he has already shown the willingness of the Labor Government to meet us half way in drawing up a naval limitations agreement. With two such frank and direct men as the President and the Premier leading the way, it is expected that definite action will be taken in the very near future. In the meantime, the public should not be misled by the propagandists, whether they be "big navy" men or pacifists. Either one may do irreparable harm.

Ugly Roads

OF the millions of people who used the highways this past summer, we wonder how many paid any attention to the ragged ugliness of newly-built and old roads alike. We wonder if the esthetic senses of many were offended by the jagged cuts, the uneven ditches and dirt piles, boulders, and tree stumps flanking the majority of roads, mute evidence of the contractor's work and the neglect of those responsible for that work.

This question of roadside unsightliness has bothered us for many years, and we've tried to understand the attitude of the average American taxpayer who apparently looks upon a road as—well, simply as a road leading somewhere. On the other hand, the Vermont Chamber of Commerce is working to beautify Vermont roads and, furthermore, to make its program a nation-wide campaign. California has lined 600 miles of roads with trees, and Massachusetts has set out 60,000 roadside trees. Indiana and Michigan last year set out, respectively, 10,000 and 40,000 evergreens; Connecticut sets out rambler roses, woodbine, and honeysuckle; while New Jersey replaces, two for one, all trees destroyed in road construction. Certain counties and communities are doing similar work. It is known that other states, also, are doing splendid work in cleaning up their roads but we have no definite records of them.

A good road is one thing; scarred roadsides another. In Europe the roads may not be quite as good as ours but it is infinitely more enjoyable to drive over them. To him who knows the joy of living—that happiest person in our frantic age—nothing can quite compare with a drive between tall and stately poplars in France, watching the ribbon of road and its tree sentinels wind away over the hills; or through dark tunnels of firs on a Luxemburg road; or beneath a canopy of blossoming fruit trees, stretching away as far as the eye can see, such as one finds in Germany. Roads in some sections of this country are comparable to one or more of these but they're hard to find. We hope, therefore, that the efforts of the Vermont Chamber of Commerce will be taken kindly and that a great deal of good will result.



Courtesy General Electric Company

SECTION OF THE RESEARCH LABORATORY IN A LARGE PLANT

With two large buildings at Schenectady devoted to research, laboratory work of the General Electric Company is carried on extensively. Many outstanding scientific discoveries with wide industrial applications have been made by the company

Wall Street and the Research Laboratory

Industries Listed on "The Street" Today at High Figures Owe Much of Their Financial Success to Scientific Research

By RAYMOND FRANCIS YATES*

IF ten economists were asked to give the cause of the great bull market in securities that has raged almost unabated for the past five years, we would no doubt obtain various answers. The layman would be quick to say that it was due to prosperity. That would be a true but superficial answer. Any theory advanced, if at all scholarly and academic, would have to include an analysis of the influence of research and invention upon the trend of security prices. The busy tickers of Wall Street today reflect not only good management and good prospects, but also the possibilities of new products from research laboratories.

The modern investor, if he is discreet and cautious in the purchase of securities, not only scrutinizes the Board of Directors, but also extends his investigation to the research department of the corporation whose securities he anticipates buying. Today the Steinmetzes and the deForests are as important in the management of corporate affairs as the Raskobs, the duPonts, and the Fishers. The real wealth of the modern corporation and the potentialities for enhancing its earnings are created in the laboratory.

PROGRESSIVE capital is today dependent not so much upon the energy and acumen of industrial leaders as it is upon science and scientific research—whether the product be automobiles, safety pins, soap, textiles, or chewing gum. Many industries have seen the writing on the wall and have either "bought" the results of organized research or have established their own laboratories. But we believe the time not far distant when possession of an individual research laboratory will be the criterion of the vision of the men behind an enterprise and an indication to the investor of its investment possibilities.—*The Editor.*

The movement of a number of securities during the past five years has given great emphasis to the importance of research as it finds reflections in Wall Street. The example of the Victor Talking Machine is a most glowing one in this respect, pointing out as it does the great force of organized investigation. Beginning in 1922, the Victor Talking Machine Company was faced with the growing menace of radio broadcasting. Its research department, incidentally, did not anticipate such a development and was faced with a crisis. It was totally unprepared to meet this fierce competition which hung like a cloud over the talking-machine industry. Talking machines were a drug on the market and the sale of records suffered enormous reduction. Here was a situation that was brought about entirely by developments taking place in the laboratories of our great electrical manufacturers. The common stock of Victor Talking Machine Company collapsed from above par down to 32 dollars per share, while the stock of the radio companies soared to undreamed-of heights. Little wonder that the modern investor should keep his eye on research.

In the midst of its troubles, the Victor Talking Machine Company turned to the Western Electric Company asking for assistance. Then a new miracle was performed. Radio, the very thing that struck the talking-machine business low, revitalized it and reshaped it with the perfection of electrical amplification and an entirely new and improved method of recording sound. The application of the vacuum tube and the photoelectric cell, to say nothing of the exponential and dynamic reproducers developed by radio engineers, made the talking machine once again a worthy competitor of radio. This new development and the increased earning power made possible were immediately reflected in security prices and the common stock of the Victor Talking Machine Company rose steadily from 32 dollars to 200 dollars per share.

---

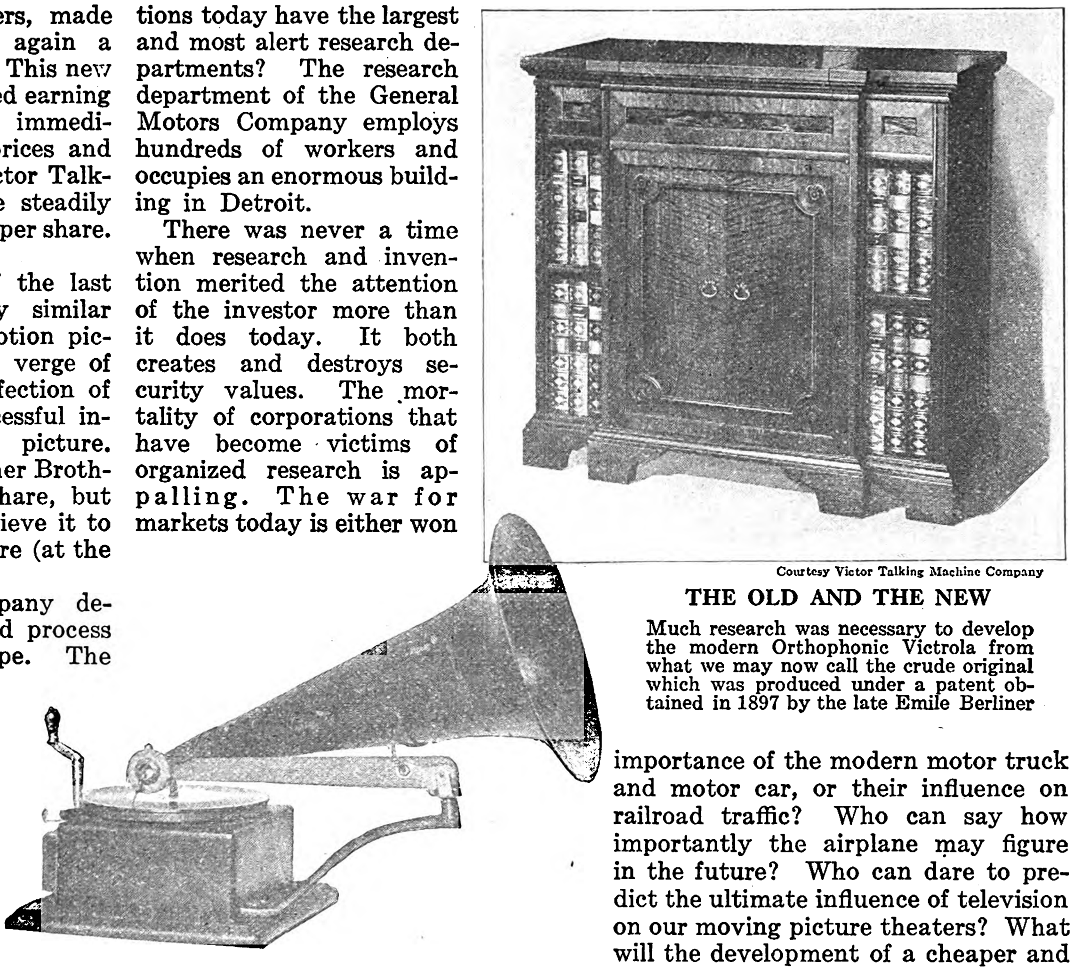
*See "Among Our Contributors," page 373.

THE financial history of the last five years offers many similar cases. Warner Brothers, motion picture producers, were on the verge of total collapse until the perfection of the Vitaphone and the successful introduction of the talking picture. Nobody wanted to buy Warner Brothers stock at 12 dollars a share, but there are those who now believe it to be a buy at 124 dollars a share (at the time this is written).

The A. M. Byers Company developed a new and improved process for the manufacture of pipe. The increased earnings and prospects brought about by this important invention were immediately reflected in the price of the Byers common stock.

Who can say what untold wealth has been added to the Eastman Kodak Company through its highly developed research department? Who can begin to determine what wealth Langmuir, with his improved vacuum tube, his nitrogen-filled lamp, or Steinmetz with his brilliant researches in alternating-current phenomena have added to the General Electric Company? Is it not significant that the greatest corporations today have the largest and most alert research departments? The research department of the General Motors Company employs hundreds of workers and occupies an enormous building in Detroit.

There was never a time when research and invention merited the attention of the investor more than it does today. It both creates and destroys security values. The mortality of corporations that have become victims of organized research is appalling. The war for markets today is either won or lost in the research department. Research brooks no armistice, perfection and improvement is its watchword, and the corporation which does not keep on its toes in research is doomed to ultimate failure. What were luxuries yesterday are necessities today. New luxuries and new comforts are being produced at an unprecedented rate and changes are brought about almost over night.



Courtesy Victor Talking Machine Company

THE OLD AND THE NEW

Much research was necessary to develop the modern Orthophonic Victrola from what we may now call the crude original which was produced under a patent obtained in 1897 by the late Emile Berliner

It is obvious from what has been said that investors must become more science-minded. They must learn to be able to sense scientific possibilities as well as business possibilities. After all, modern business men are called upon to exploit the products of engineers and physicists. It is the research worker who is the Power Behind the Throne. It is he who supplies the sinews and ammunition of modern commercial warfare. The Big Berthas of business boom with his ideas.

Courtesy Victor Talking Machine Company

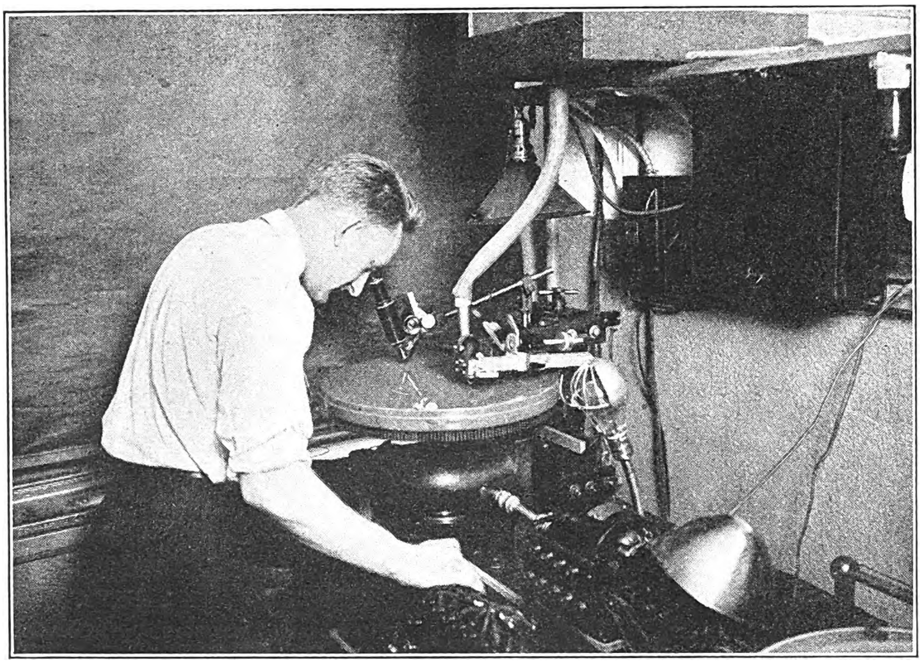
VICTOR RADIO

The radio, developed by research, threatened the existence of the talking machine; the two became partners

Many of our modern inventions have become such commonplaces that it is difficult for one to realize the extent of their economic importance. Who can begin to calculate the importance of the modern motor truck and motor car, or their influence on railroad traffic? Who can say how importantly the airplane may figure in the future? Who can dare to predict the ultimate influence of television on our moving picture theaters? What will the development of a cheaper and more reliable oil burner do to the coal industry? One has but to review these possibilities to realize with inescapable conviction that the factors which influence security values are growing more complex daily.

When the research laboratories of the duPont Company finally perfected lacquer, it not only added greatly to its earning power, but for the moment it adversely affected the earning power of the paint manufacturers producing enamels. This startling development came like a bolt out of the blue. The paint industry suffered a revolution almost over night. New industries are built up and many old ones are torn down. The research chemist is working new miracles every day and one cannot begin to recount the diversification of research that is today taking place in the electrical laboratories of the country.

TWENTY-FIVE years ago there was little organized investigation. At that time most of the important researches were either conducted in private laboratories or in the laboratories of universities. The modern industrial research laboratory is largely a product of the last 15 years. Business men, once so skeptical of the genius, now provide him with lavish support that he may bring his ideas to fruition. Not only that but he is given ideas to perfect. It is not uncommon today for a Board of Directors



SCIENCE ENABLES THE "MOVIES" TO SPEAK FOR THEMSELVES

Above is shown the recording apparatus of the Vitaphone talking "movie" system; at right a "frame" of a Movietone system film, showing sound strip. Both are research products

to prepare a requisition for a new product and even to specify its necessary properties and characteristics—whether it be an electrical refrigerator or a substitute for insulin.

What ten years ago were considered purely academic and even classical researches are being applied industrially today. Little did Hertz or Hallwach think that their investigations into the photo-electric phenomena would some day be used for sorting cigars or indicating the amount of smoke passing up a chimney. Cottrell was quick to apply the laboratory experiment to the precipitation of solid matter from smoke, a development which has saved the big smelting companies many millions of dollars.

THE mass production of commodities has been brought about entirely through the researches of mechanical and electrical engineers. The 5 and 10 cent store has been made possible through mass production brought about by better punch presses, better and faster looms, better paper-making machinery and a thousand and one other developments which have speeded up production facilities. The chain store represents nothing but a more intensive method for the distribution of products whose manufacture has been greatly cheapened through the efforts of inventors and paid research workers. Commodities become antiquated quicker today than ever before; the new is always replacing the old. Somewhere, someone has a better idea. Economics are in a constant state of flux. Change, revolution, and decay are the materials from which progress is made.

Mr. Maurice Holland, the Director of the Division of Engineering and Industrial Research of the National Research Council has compiled some most interesting statistics based on a questionnaire sent out last year to no less than 5000 manufacturing concerns, each having a rating not under 1,000,000 dollars. Each recipient of the questionnaire was asked for information regarding their research activities.

The results of this investigation revealed the constant and gratifying growth of organized investigation and its relation to industry. An analysis of 599 of these questionnaires showed that 52 percent reported that research was a very definite part of their program. Results showed that testing laboratories were conducted by 7 percent and that these testing laboratories were established in an effort to improve products. Part of the report follows:

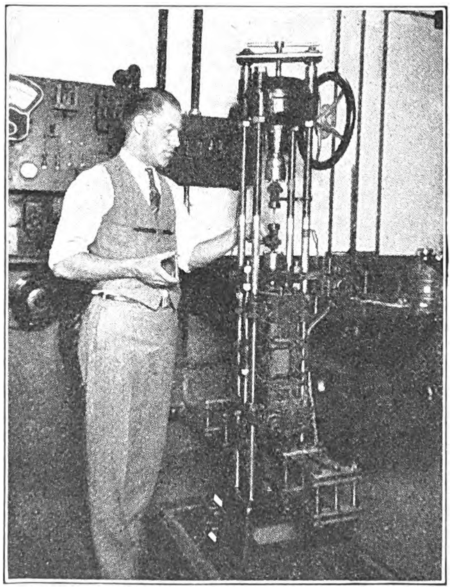
"In regard to co-operative research conducted through trade associations, engineering societies, universities, or endowed fellowships, 29 percent reported that they were supporting such activities. An additional 15 percent stated that they were considering extension of their research activities, and 11 percent of those doing no research work at the present time reported that they are considering taking it up in the future.

"Turning to the nature of research progress, as revealed by the replies to the questionnaire, major emphasis seems to be on the improvement of product and service. It was possible to divide the programs submitted into five classes, the arrangement being in the order of importance: (1) Improved product of service, 67 percent; (2) Reduction of production costs, 59 percent; (3) development of new fields of application, 40 percent; (4) by-products and new materials, 30 percent; (5) new products, 8 percent.

"ONLY a few, twelve in all, specifically mentioned the elimination and utilization of waste. However, from the nature of the replies, the conclusion is justifiable that many concerns interested in this subject included this element in their program under the heading of by-products and new materials.

"As to the ratio of profit to the amount expended, numerous estimates range from 100 to 300 percent."

It would be most difficult to determine the tremendous wealth that has been added to the United States by research during the past 20 years. The security holders of corporations engaged in research have benefited most directly. Research not only permits manufacturers to broaden their scope of activity by the development of new products, but also to eliminate competition through the improvement of products already manufactured.

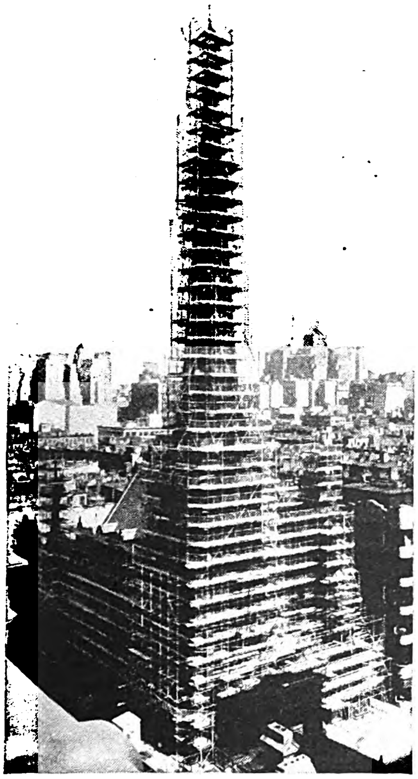


Courtesy Westinghouse E. & M. Co.

FATIGUE TEST

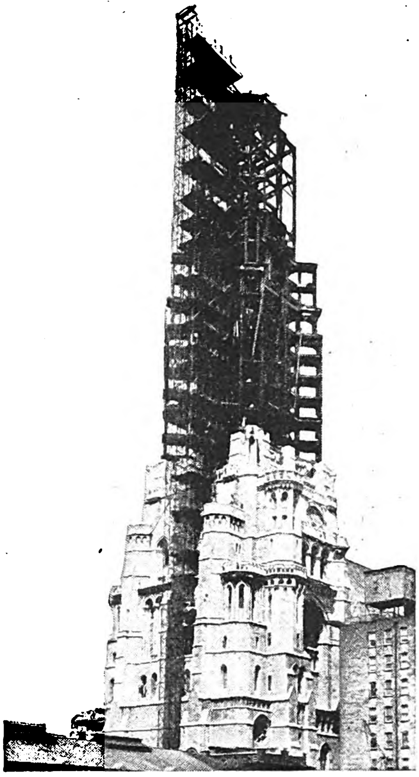
Under constant vibration, a metal becomes fatigued. In this test, metals are given millions of vibrations to determine their ability to resist fatigue

Safe, Fireproof, Steel Scaffolding



NO FIRE HAZARD

The new steel scaffolding and fireproof floor planks used in renovating a church



ON A CHURCH TOWER

The new scaffolding may be used for such structures as working elevators

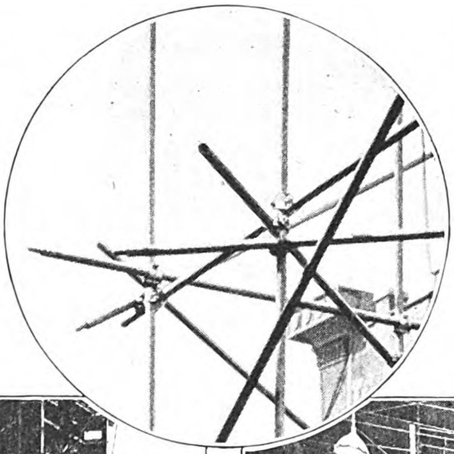
RECENTLY many people have noticed, particularly in the larger cities, and marveled at a new type of steel scaffolding which seems to form a veritable network about the sides of buildings under construction, or undergoing the process of renovation. This steel scaffolding was originally adopted primarily for the sake of safety, compactness, and durability, but within recent months another feature—the fireproof quality—has come to be recognized and appreciated more than ever before due to the occurence of several serious fires in wood scaffolds.

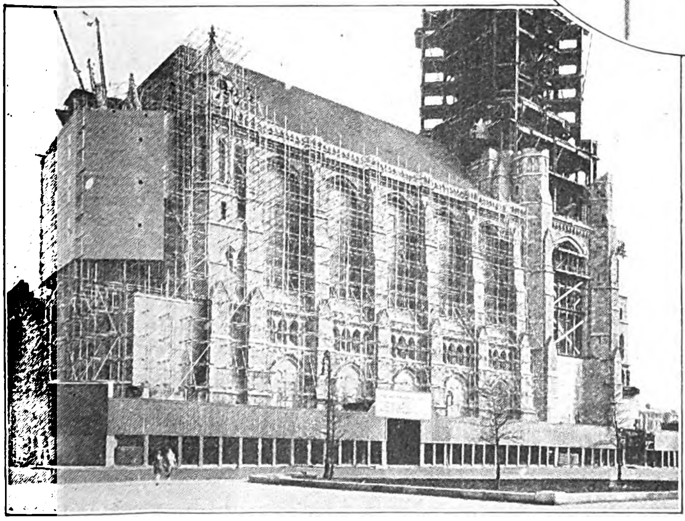
During the winter of 1928 a fire started in the wooden scaffolding of the 5,000,000-dollar Riverside Church, New York City, and before it was brought under control, delicately carved masonry work was ruined to the extent of 1,000,000 dollars. Similar fires, occurring in many cities, are really preventable because metal scaffolding can be used.

It is to be seen, therefore, that the new steel scaffolding furnished by the Patent Scaffolding Company fills an important place in the structural field. The scaffolding consists of tubular members having an outside diameter of two inches and galvanized to protect them permanently against rust and discoloration. These tubes are furnished in 6, 10, and 13-foot lengths. They are clamped together at right angles by standard couplers, and at any other angle by means of adjustable couplers, both types of which are simply bolted together tightly. The tubes are connected in series by means of a unique locking device which allows the end of one tube to be inserted into the end of the adjacent tube, this connection giving a positive and rigid locking connection between the members. For the vertical ground members of a steel scaffolding framework, bases are supplied, these to rest either on the concrete of the sidewalk or on wooden blocks. Cross members called "putlogs," are used to support the scaffold planks. Sometimes the ends of these members are locked into the brick wall by means of a clincher plate. The distinctly blue-tinted wooden planking is fireproofed by means of chemicals which are deeply impregnated under heavy pressure so that they are not washed out.

CONNECTING CLAMPS ➤

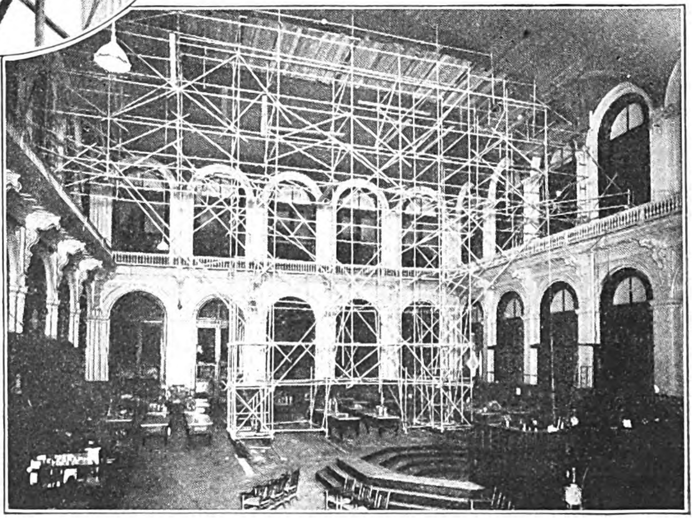
The clamps used for connecting the members, and the method of reinforcing





ONE FIRE WAS A LESSON

The Riverside Church, New York, where a scaffold fire caused great damage, now uses the new steel scaffolding for safety



INSIDE—WORK IS NOT INTERRUPTED

The steel scaffolding, used for renovation or repairs of walls and ceilings, does not interfere with office routine or cut off light.

Synthetic Sweet Smells

How the Synthetic Chemist Converts Foul-Smelling Substances Into Pleasant Perfumes to Disguise Products We All Know

By **DONALD A. LAIRD, Ph.D., Sci.D.**
Director, Colgate Psychological Laboratory

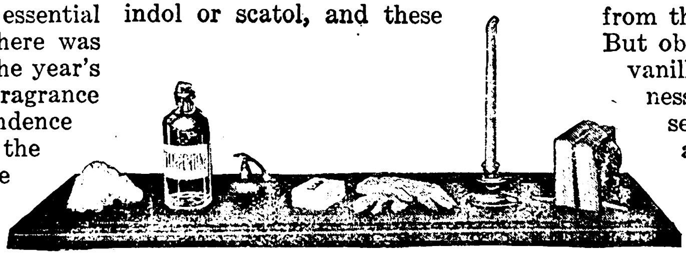
OLFACTORY EXAMINATION

The "snooper" sniffs a paper dipped into each bottle. Those not "up to snuff" are rejected, as explained in the text. Only a fraction are accepted

SOMEONE once raised the question as to how a skunk and a chemist are alike. The answer used to be that it was a marvel that they could stand the odors they created.

A new answer will have to be devised for this apparently pointless query. Chemists are beginning to work magic with odors, just as they have been creating marvels by combining metals into alloys. We may perhaps imagine that the chemists began working to create bigger and better odors largely in self-defense—they wanted to be able to stay in their own laboratory workshops. Whatever the initial motive, the development of synthetic fragrances has now become an industry.

A FEW years ago we could purchase deodorized shoe polish only at a premium. So long as man had to depend upon nature's limited supply of essences the price was high. One of the principal industries of Bulgaria was growing flowers for the extraction of their essential oils to use in the manufacture of fragrances. This was also the leading industry around Grasse, in France. But when there happened to be too much summer rain in Bulgaria the price of these essential oils went skyward. When there was a late spring around Grasse the year's crops did not have the same fragrance as usual. Thus, when dependence was placed almost solely on the vicissitudes of nature the price of essences was unstable, and the qualities varied from season to season.



SYNTHETIC SMELLS YOU SMELL

Crude brown camphor and turpentine (at left) are converted to synthetics and are sprayed from the atomizer on these products

Somewhat more than a quarter of a century ago a thin and rather short student at the University of Zurich neglected to follow all the routine his professors wanted him to follow in the chemical laboratory, and began to experiment with the odors given off by various chemical compounds and processes. Leon Givaudan thus managed to discover how to make some odors remarkably similar to those produced by nature, and began manufacturing a few even before he had completed his college course.

At first Givaudan concocted his powders and oils in his boarding house, but, since some of the intermediate stages produced odors greatly in contrast with those reached after the final steps had been completed, his landlady reluctantly, but decisively, threw him out. He moved into a poorer section of Zurich, but there he fared no better: again he was thrown out. Some of the nauseating odors he produced were accidents, due to getting on the wrong experimental course. Some of them, however, were (and still are), an inevitable occurrence in the manufacture of an end product which is markedly pleasing. This is one way in which synthetic aromatics resemble alloys. One can never tell, until he tries, just what the odor will be, and in many instances it is the opposite of what is expected.

For example, it has been discovered that in making an artificial jasmine odor the best results are obtained by adding a small amount of amylcinnamicaldehyde. Now this aldehyde, of itself, is far from pleasing to smell. Its aroma resembles that of old-fashioned-tasting castor oil, or "overripe" fish. Natural jasmine contains indol or scatol, and these smell like a clogged cess-pool. The other odors in jasmine do not, however, produce the fully pleasing olfactory harmony without the addition of these "sour notes." It took some time for the synthetic chemists to discover that beautiful fragrances could sometimes be improved by the addition of a sour note or two. A psychologist might expect just such an occurrence, for mild discords are known to enhance musical harmony under the proper conditions.

Synthetic fragrances have another resemblance to synthetic metals, or alloys: some of the chemically pure synthetics have the same chemical composition as that product of nature whose odor they duplicate. Such a case is synthetic vanillin. Other of the synthetic fragrances are produced by chemicals with formulas very different from those of the natural compound. This is illustrated by synthetic musk, which is produced from unusually strong nitric acid at a temperature much lower than that, let us say, of any electric home refrigerator.

ARTIFICIAL vanillin is made from clove spices, usually imported from Zanzibar in Africa. Clove oil is, of course, extracted from the spice after these spices have been removed from their packing of palm-leaf bags. But obtaining clove oil and synthetic vanillin does not end the usefulness of the spice. Some firms sell the so-called exhausted hull as fertilizer — which indicates that the hull is far from exhausted.

Other firms, who do not grind the hull in their processes, color them artificially after the oils have been removed, and ship them across the ocean again, this time to India where they are used in burial ceremonies. It is also possible that a few of the exhausted whole hulls which have been re-colored are bootlegged into the grocery market.

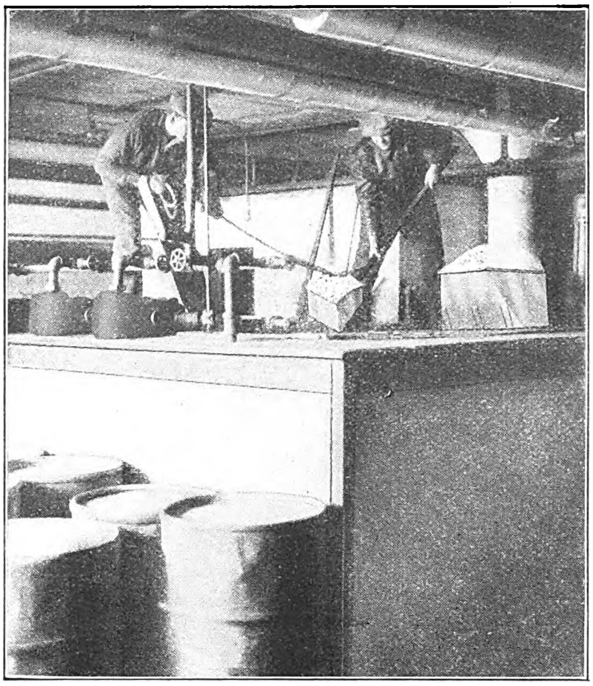
It is from the eugenol in clove oil that vanillin is produced. Eugenol needs only the addition of oxygen to change it into vanillin which is exactly like the vanillin extracted from the vanilla bean itself. Vanillin, however, is itself, very different in odor from vanilla. This is because vanilla is a complex affair, like jasmine, and vanillin gives only the high note of the olfactory chord that produces the typical vanilla aroma. Again we are reminded of the almost unpredictible vagaries of alloys.

Under the wand of the synthetic chemist, camphor becomes heliotrope. Brown camphor oil from Formosa is distilled by steam and comes out white—but still unmistakably camphor. Safrol is one of the ingredients in the camphor, and it is from this that heliotrope is made. The safrol is obtained by pumping the white oil into a brine tank with artificial ice. This freezes out the safrol, and the other ingredients are removed by centrifuging. All that is necessary in order to change safrol into heliotrope is to add oxygen to it. Now this sounds relatively simple, and in fact it is simple. It could be accomplished by blowing air through the safrol in the presence of ultra-violet rays from a quartz-mercury lamp. In most cases, however, a more roundabout but more satisfactory way is used: Bichromate of soda and sulfuric acid are added to the safrol in order to introduce the oxygen; after which the excess acid and soda are washed off.

To me, the transformation of crude turpentine into delightful lilac is usually striking because of the almost overpowering stench of the turpentine itself. That it might yield any olfactory virtues taxes the imagination. It is also especially interesting to me because of an entertaining experience I had a short time ago, after spending a day watching the manufacture of artificial lilac. After being close to the stills and separators all day long my clothing had become lilac-impregnated. I boarded a crowded motor bus at Passaic, New Jersey. It was a rainy day and practically every passenger had damp outer clothing, which produces an unpleasant stuffy odor. To this my own clothing apparently provided a "high note" for the passengers' nostrils. In the seat just ahead of me was a middle-aged man who looked as though he might have been a prize fighter or a professional thug. Soon I noticed that from time to time he tilted his head slightly upward and took deep inhalations. In a short time he was turning toward me. It was not comfortable to have what might be a thug sizing one up so frequently.

When the terminal was reached, my thug came to me, extended his hand and said, "An hour ago I would have been suspicious of a man smelling as you do; but now I want to thank you. I was sitting beside someone who had been eating garlic and I could not have stood the ride if it had not been for you!"

Terpinol is synthetic lilac, made from oily, stenchy turpentine. The crude turpentine is agitated with acid and is transformed into terpine hydrate. The hydrate is a finely granular material which looks like pancake flour. Incidentally, it also smells like pancake flour. The terpine hydrate is transfered to a still, and phosphoric acid is added, transforming the hydrate into crude terpinol. The crude terpinol is oily and is mixed with water. The product from the still comes into a separator in which the oil rises to the top and is skimmed off from time to time by the operator. This is just crude terpinol and still has much to be done to it before artificial lilac is produced.



SAFROL EN ROUTE HELIOTROPE

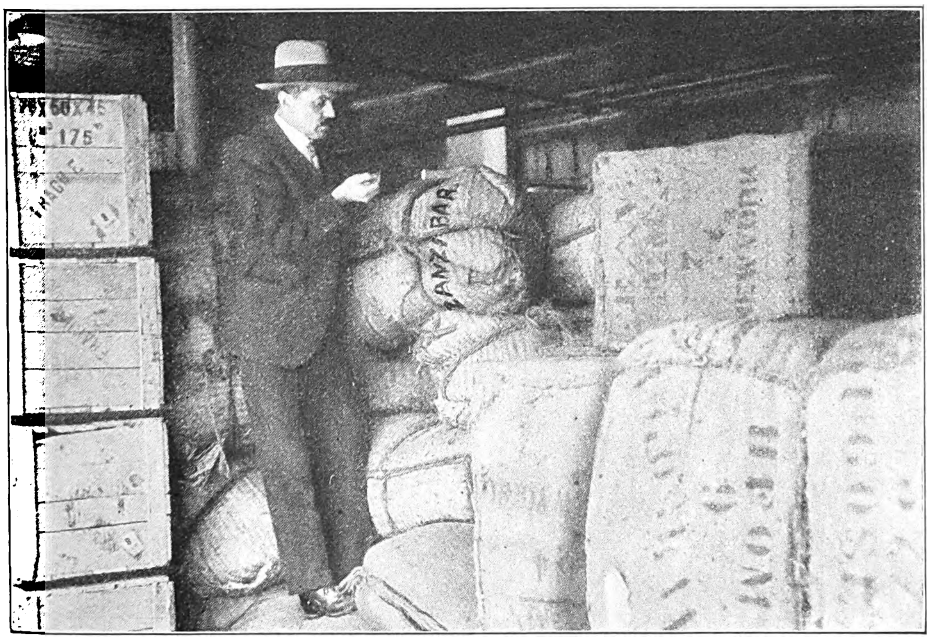
Scooping safrol crystals from the brine tank after the crude brown camphor has been treated by adding oxygen

The crude terpinol is transfered to a vacuum still, since the final product must not only be exceptionally pure, but must also have a high boiling point if it is to have a lasting fragrance.

The first product to come out of the vacuum still containing the crude terpinol is turpinolene. This is used to perfume cheap soaps. The second stage of the distillation yields a mixture of terpinolene and pure terpinol and this is not usually used. Finally, amber clear and pure, the terpinol comes from the vacuum still.

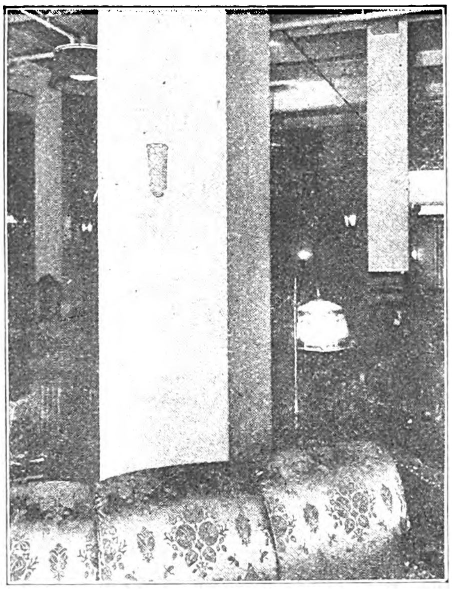
The vacuum distillation is extremely important in the manufacture of most synthetic fragrances. The air is continuously pumped out of the stills, so that the pressure inside is equal only to that of two millimeters of mercury—ordinary atmospheric pressure being 750. The stills are heated by circulating oil which is maintained at a temperature of around 428 degrees.

One is reminded again of the difficulties of the manufacture of alloys, for the distilled product may be chemically pure to 99.999999 percent, but still not be olfactorily right. So the distillate is collected in gallon glass jugs and placed on a rack waiting the pleasures of the "snooper." On the factory pay roll this functionary is usually known as the perfumer, but the still operators have given him the unaffectionate but appropriate title of



RAW MATERIALS FROM THE ENDS OF THE WORLD

Such raw materials as these, roots from Yugoslavia and cloves from Zanzibar, are converted into synthetic aromas. Dr. Eric Kunz is shown making a visual inspection of the materials



A "FRAGRANCEER"
To neutralize odors the receptacle on the post is impregnated with synthetic aromas

"snooper." He is necessary because a chemical analysis will not tell whether the odor is satisfactory or not. The snooper will mark one gallon to be redistilled; another he will accept; another he will mark to be discarded entirely as not even worth redistilling. As a rule he accepts only about one out of three or four gallons. In practically every plant where synthetic fragrances are manufactured his word is absolute and final. The snooper is king. Usually three vacuum redistillations of a gallon are required by him before the product is accepted as correct in smell.

Any chemical student can make phenyl ethyl alcohol that is 99.99 percent pure chemically. It is likely, however, to smell like a radish. It has possibilities of becoming a delightful rose scent if handled right, and the snooper keeps marking it for redistillation until the odor passes his critical test. Needless to say, the snooper or perfumer is an individual on whom the board of directors must depend, and whom the workmen hate in a friendly sort of a way.

SINCE many of the products finally accepted by the perfumer are later to be used by other manufacturers in making toilet waters, soaps, and actual perfumes in which the color of the product is essential, the manufacturing problems of the synthetist are further complicated. Most chemical manufacture requires simply strength and purity but in the manufacture of dyes the factor of color is added. The manufacturer of synthetic fragrances must meet all three of these requirements of purity, strength, and color; to which the fourth ingredient of odor is also added. That is why we cannot solve our home perfume problems by buying phenyl ethyl alcohol of guaranteed purity and expect to obtain a rose fragrance. We are more likely to get the aroma of radishes.

The stills, separators, agitators, and brine tanks of the chemist have produced more odors, and these in greater quantities, than nature has provided. Thus the price of these products has come within the reach of all. Further, they have been standardized scientifically. A pound of 10 percent violet used to cost 400 dollars, and the quality was not to be guaranteed. A pound of 100 percent concentration of synthetic violet of guaranteed fragrance and color can now be bought for four dollars.

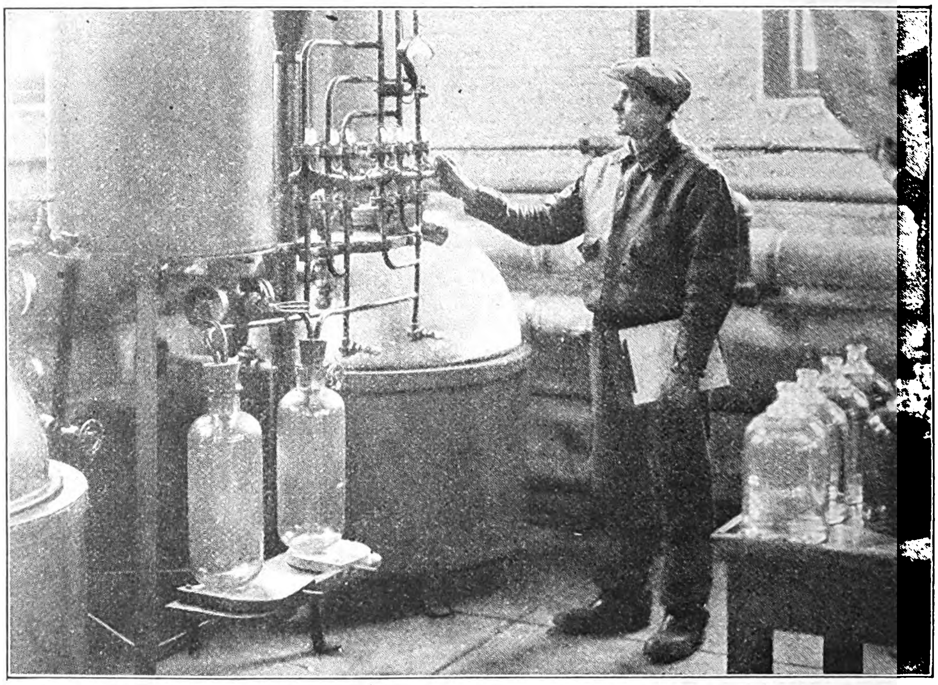
Naturally, many manufacturers have discovered that olfactory qualities, if added to their products, will increase satisfaction and demand. Some fly sprays now contain from three to six percent of synthetic fragrances. These counteract the otherwise repulsive odor of the spray. Some manufacturers are even scenting their leather gloves, especially when the gloves are designed for the fair sex. Synthetic fragrances are being added to candles, in some cases merely to offset the odor of burning; in others a delicate additional fragrance has been added. And it has been discovered that adding as little as 0.2 percent of the proper synthetic fragrance to quick-drying but smelly lacquers will overcome the strong odor of bananas.

LAST summer when one of New Jersey's numerous bachelor millionaires was giving an old-fashioned barn dance the voracious Jersey mosquito gave threat of being a disturbing element. The millionaire called in a synthetic chemist, who added a scent of new-mown hay to a mosquito spray. A good time was had by all except the mosquitos.

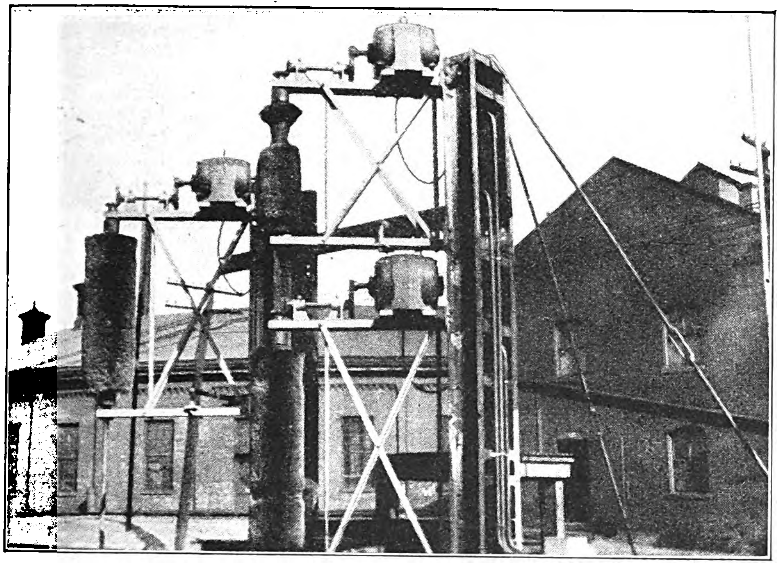
The great increase in cigaret sales is due to a considerable extent to the use of fragrances of one sort or another that have been produced by the synthetic chemist. Of course, one can not say exactly how much of the increase is due to this factor, for there are also the factors of advertising and prohibition and generally changing social habits to take into consideration. Still, the artificial odor must be important, for no cigaret has succeeded without it. The favorite synthetic used in cigarets is counarine, which has an odor like new-mown hay or the tanka bean, or is somewhat suggestive of maple sugar. One cigaret manufacturer has discarded the synthetic and uses something like four million pounds of real maple sugar annually.

THE specialist in synthetics has reached the point where he can now say with confidence that there is not an odor that can not be overcome by a synthetic. Moreover, it can be kept overcome for as long as half a dozen years. This accomplishment is a direct result of repeated high-vacuum distillation. Out of the smelly chemical laboratory has come this almost unlimited choice of fragrances.

¶ *Our next number will be devoted largely to archeology, a science which is on the gain both among professional workers and amateur scientists. There will be articles about the prehistory of France, new discoveries in England, the Neanderthal race, and other topics.*

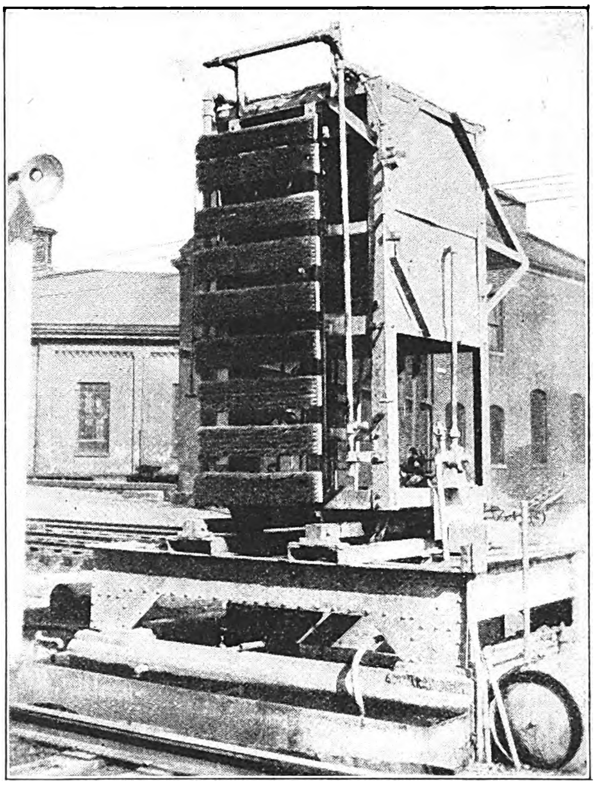


HIGH VACUUM DISTILLATION OF SYNTHETICS
High vacuum distillation and redistillation is essential to obtain high boiling points and good aromatic qualities. The lasting qualities of synthetic odors are due largely to this



THE WASHING MACHINE

Photograph taken from the track side of the device, showing the assembly of the motors and vertical brushes which turn at 300 revolutions per minute



THE SCRUBBING MACHINE

The entire assembly can be moved toward or away from the side of the car. Oxalic acid is kept in a tank

Cleaning Railway Cars

Efficient Machinery Replaces Slow, Inefficient Hand Labor

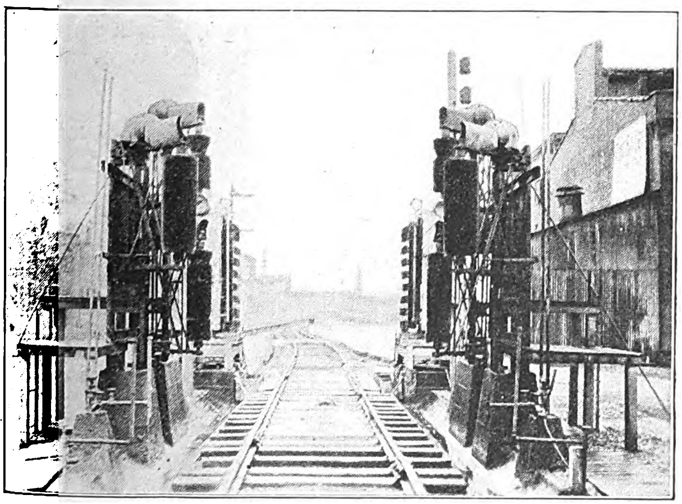
KEEPING passenger cars of steam railroads clean and presentable has always been a difficult and expensive task. For this reason the Baltimore & Ohio Railroad started experimenting several years ago to develop an economically operated car-cleaning machine. The result was the development of two kinds of car-cleaning machines, one a car-washing machine which uses water only and has its revolving brushes work vertical to the sides of the car, and the other a car-scrubbing machine which uses oxalic acid and has a series of horizontally-placed brushes which operate with a reciprocating motion.

The car-washing machine consists of two structural frames rigidly supported from the ground, one on each side of the railroad track. On each of the frames are mounted three vertical rotary brushes, each in a swinging frame which is actuated by a tension spring and lever to keep the brush in contact with the irregular surface of a car side. Each brush is driven by an electric motor and makes 300 revolutions per minute. On each side of the car is a standpipe through which water at high pressure is sprayed.

THE car-scrubbing machine is located on the same track and is also made up of two frames, one on each side of the track. Each frame has an electric motor which operates the brushes. The mechanism is arranged so that each frame may be moved by motor in and out from the sides of a car.

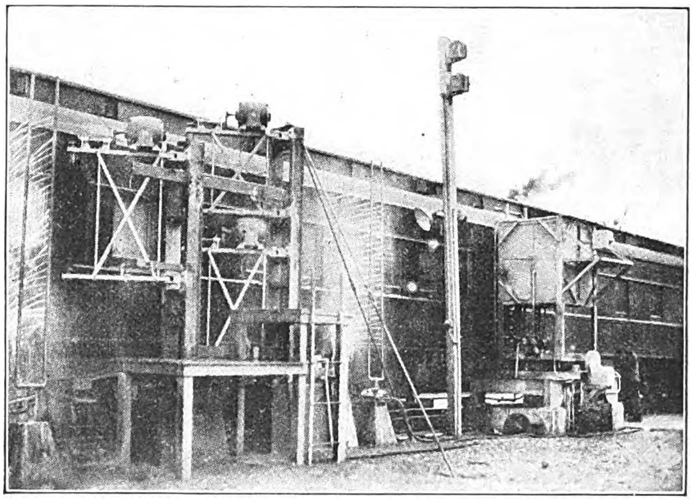
The acid solution is kept in a tank and is forced by a pump through the spray pipes directly over the brushes. The equipment below the body of a car is cleaned by the use of short standpipes through which a solution of steam and caustic soda is forced.

A force of five men is required to operate both the machines. In an eight-hour day this force has cleaned 100 cars while the old manual method required eleven men to clean one car in an hour.



THE COMPLETE CAR LAUNDRY

In the foreground are the two washing machines, one for each side of the cars, and in the background are scrubbing machines



ONE HUNDRED CARS PER DAY

Cars are moved slowly through the laundry. Very dirty cars are scrubbed and washed; those only slightly soiled are washed

Ice by Wire

The Tireless Electric Refrigerating Unit Is Displacing the Ice Man As Surely As Artificial Ice Displaced Nature's Product

DURING the year 1928 approximately 450,000 domestic electric refrigerators were sold and installed in homes in the United States, and this year the number sold will be approximately 600,000. The growth of this industry during the last few years has been remarkable, and the future cannot even be forecast.—*The Editor.*

EARLY in the history of mankind came the knowledge of how to make simple household vessels of sun-baked clay and later similar vessels crudely baked by fire. Someone soon discovered that water kept in a covered porous jar of this sort remained deliciously cool. He saw the beads of moisture upon the outside, but never suspected that the evaporation of the liquid through the porous surface of the jar caused the pleasant coolness.

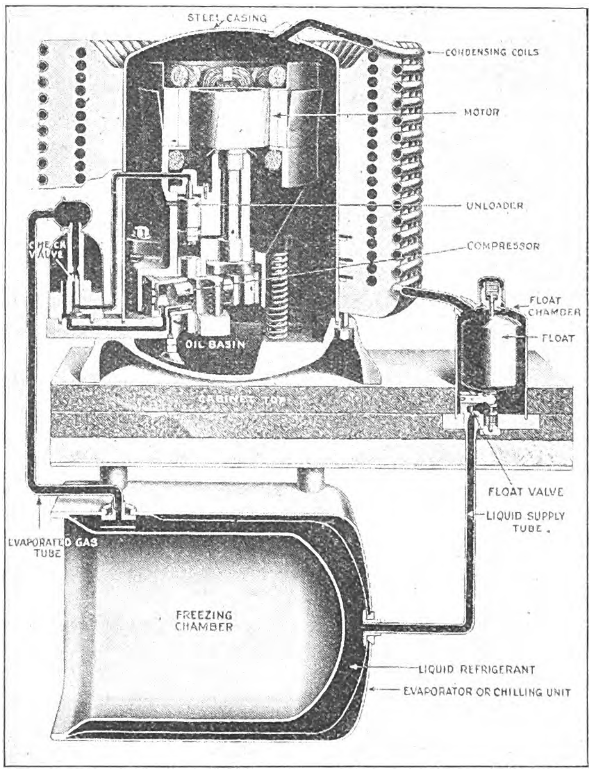
The use of ice and snow as cooling agents for food was known as far back as the ancient Egyptians, who filled shallow, porous trays with water and placed them on beds of straw. They were exposed to the cool night breeze, and due to the coolness and evaporation a thin film of ice was formed, which was removed at dawn by slaves and stored away. The same practice is followed even today in India.

Alexander the Great had his serfs carry down packed snow from the mountains, and place it in deep trenches with hundreds of kegs of wine, so that his epicurean feasts might be graced with cool vintages. Nero followed a similar course, employing an army of slaves to keep his rare wines cool. Marco Polo, the great Italian adventurer in the Middle Ages, brought from China and Japan recipes for water and milk ices.

CATHERNIE DÉ MEDICI in the 16th Century, visiting France, took with her a favorite chef to make sure that she would be served each day with frozen creams. Sir Walter Scott tells how, during the Crusades, Saladin, King of the Moors, amazed Richard the Lion Hearted by sending him a gift of frozen sherbet.

In the Elizabethan age, Sir Francis Bacon, in one of his greatest books said: "Heat and cold are Nature's two hands whereby she chiefly worketh, and heat we have in readiness in respect of fire, but for cold we must stay till it cometh or seek it in deep caves or mountains, and when all is done, we cannot obtain it in any great degree; for furnaces of fire are far hotter than a summer's sun, but vaults and hills are not much colder than a winter's frost." It has been stated that the great Sir Francis really died because of his scientific zeal concerning refrigeration. One winter day he ordered his carriage to halt while he climbed into a snow bank and filled the body of a chicken with snow, intending to discover if the flesh could not be longer preserved by such treatment. He became chilled through and soon contracted pneumonia from which he died.

A hundred years ago Michael Faraday succeeded in condensing ammonia gas to a liquid by applying pressure and then cooling. When the pressure was removed the liquid quickly vaporized, absorbing heat from its surroundings in the process. Here was discovered the first principle of mechanical refrigeration.



CROSS SECTION OF THE REFRIGERATING UNIT

Refrigeration in a larger sense is a problem which interests every man, for without it our daily menu would be restricted to that produce which is native to the locality in which we live. Any attempts to overcome the barrier of time and distance without refrigeration would soon result in metropolitan areas over-ridden with disease and pestilence of a magnitude heretofore unknown. Refrigeration allows a continuity of flow through the different channels of distribution which makes us not only husband our dollar, but also gives us food when and where we want it. Large refrigerating plants may house millions of dollars worth of perishable merchandise, but their dealings are all of a wholesale order. All the tangible advantages of the large establishments, even to freezing desserts or making ice cubes, are now available for every home. It may be said that about equal credit belongs to France, England, and America for the early development of ice-making machines. Doctor Gorrie of Florida took out the first American patent for a practical machine in 1845.

The harvesting of natural ice was always a picturesque affair. Where are the 160 ice houses which flourished on the banks of the Hudson in 1880? Most of them have gone into decay, some of them are used for mushroom growing, and many are still waiting for the roof to fall in. The reason for the change is the rise in labor costs, improved utilization of power, and improved generation of power. Labor was the largest factor in the cost of natural ice. But labor is only one quarter of the cost of artificial ice.

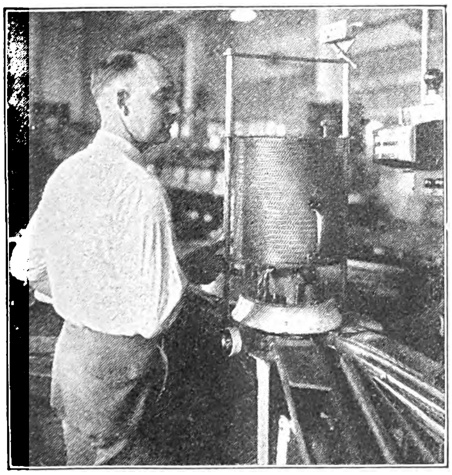
IN the last few years the trend has been, and still is, toward automatic refrigeration. And because of the research and educational activities of the manufacturers of these machines, the influence is felt in homes where formerly little or no thought was given to the preservation of food. It has been found that most food keeps best at a temperature of between 40 and 50 degrees, Fahrenheit, as in this temperature destructive bacteria are practically dormant. Harmful bacteria develop by leaps and bounds in moist temperatures above 50 degrees, with the result that there is much waste due to food spoilage.

Many improvements have been made in the last few years, both in ice and automatic refrigeration cabinets. Manufacturers of electric refrigerators have developed their mechanism to the point where it is extremely efficient and requires, proportionately, less servicing and attention than the family automobile. Artificial ice has very largely displaced natural ice and the new refrigerators, whether they derive their cooling power from electricity, gas, or even kerosene, are making the daily visit of the ice man only a memory in thousands of households throughout the land.

Over a quarter of a century ago a French monk, the Abbe Audiffren, designed a hermetically-sealed refrigerating machine. Some of the earlier machines are still running, never having been refilled with oil or refrigerant. The idea was excellent, but it remained for the American refrigeration engineers to develop this idea and make it an everyday article of commerce. Fifteen years of research are behind the General Electric refrigerator which we will describe. An immense fortune was spent in investigating and experiment, but this comes back as the refrigerator units and their cabinets come down their respective assembly lines. The unit and the cabinet never meet until they are placed one on the other in their owner's home or store.

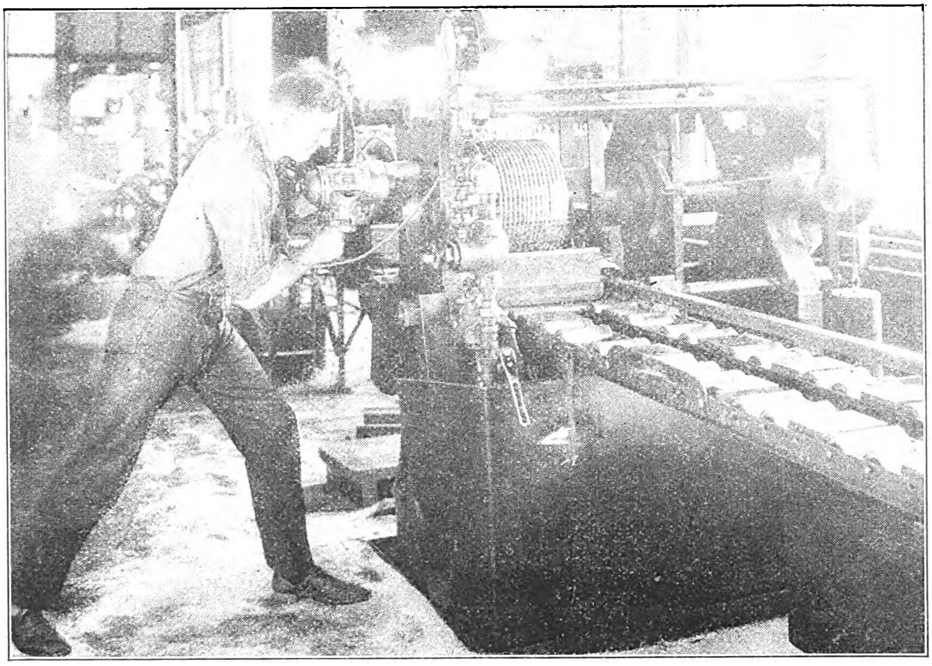
THIS refrigerating unit, as illustrated, has the motor and compressor mounted inside a hermetically-sealed casing. The compressor is directly connected to the motor, eliminating the necessity of a stuffing box and external belt or gear drive. This mechanism is then mounted on a base which forms the cabinet top and together with the evaporator or chilling unit completes what is usually termed a "packaged" refrigerator.

By confining and controlling the chemical refrigerant within the food compartment of the cabinet, and allowing it to boil or evaporate, a certain amount of heat is absorbed. If the vapor is then carried to a point outside the cabinet and condensed, it will give up this heat and the cycle may be repeated until the desired temperature has been reached within the cabinet. The chemicals which are used for refrigeration are liquefiable gases having a low boiling temperature and a high latent heat of vaporization. Sulfur dioxide, methyl chloride, ethyl chloride, ammonia, and carbon dioxide are the principal refrigerants used in household refrigerating systems. Sulfur dioxide, which is used in the machine we are illustrating, boils or evaporates at 14 degrees above zero at atmospheric pressure. It is a colorless, non-poisonous, non-inflammable gas and has no corrosive effect on copper, copper alloys, or iron. Leaks are easily located by using ammonia water, a dense white smoke being formed when the ammonia and the sulfur dioxide react. On account of its many good qualities, sulfur dioxide is used in the larger part of household machines.



HIGH-POTENTIAL TEST

Motor is receiving the first high-potential test, prior to the motor-pump test



A "TWO-IN-ONE" OPERATION

A hydraulic press applies pressure to the refrigerator-case assembly. Opportunity is given to tighten 18 bolts, which secure the drop-forged base of the unit, with an electric wrench

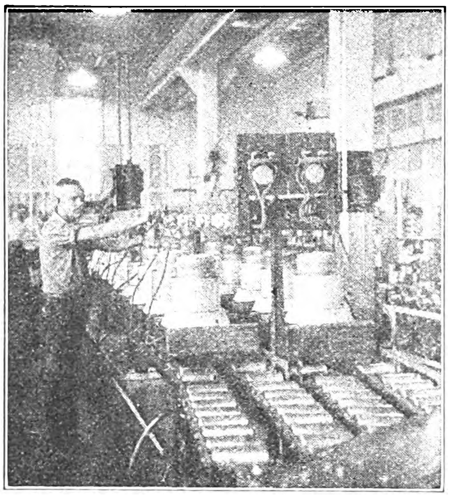
The cycle of an electric refrigerator is automatically continuous. The gas first evaporates (absorbs heat) and cools the cabinet; it is then compressed and cooled in the condenser, giving up its heat to the surrounding air. This cooling under pressure causes the vapor to re-liquefy and it returns to the evaporator to be evaporated again. It will make no real difference which part of this cycle we begin with in explaining it, so let us begin with the pump or compressor. The pump sucks sulfur dioxide in gaseous form from the evaporator, which is located in the food storage chamber. This reduces the pressure on the liquid sulfur dioxide remaining in the evaporator and it therefore evaporates rapidly. That is, it boils.

This boiling may be heard faintly by placing the ear close to the evaporator. It sounds much like the bubbling of a boiling pot of cereal or stew. All liquids boil at lower temperatures when the pressure on them is reduced. Water, for example, will boil at lower temperatures on a mountain, and at common room temperatures in a near vacuum. The boiling of sulfur dioxide is therefore a common physical phenomenon of liquids.

Why boiling should deliberately be brought about in a refrigerator has puzzled many. The reason is that when a liquid boils it takes up heat. In fact, it can not boil without taking up heat. In this case the heat is taken from the food in the refrigerator, which is just what we most want. This same heat appears in the spiral coil on top of the refrigerator. It may be thought of as heat removed from the stored foodstuffs, conducted to the coil, and then cast out. Therefore, an electric refrigerator is simply an apparatus for "kicking out heat from places in which it is not wanted." The kick comes in over the electric power lines.

TO continue the cycle, the remainder of the apparatus is simply for reliquefying the vapor so that the process we have just described can go on indefinitely. The pump driven by the motor, which, as described, has just sucked sulfur dioxide vapor or gas from the evaporator, compresses this same vapor in the large central cylindrical shell. This may be seen lying within the outside spiral coil.

When a gas is compressed it increases in temperature. This is because it occupies only a fraction of its former volume but retains its former quota of heat. Therefore, its tempera-



MOTOR-PUMP TEST

The units must undergo a motor-pump test. This is one of sixteen major tests

ture goes up. The same thing occurs when you pump up a tire with a hand pump; the air in the pump becomes heated and heats up the cylinder itself, as can readily be felt. Likewise, the central shell of the refrigerating unit becomes hot—just a little too warm to hold the hand on very long.

The warm, compressed vapor within the central shell next passes into the spiral coil, which has a large cooling surface. Here the vapor cools down nearly to room temperature. This causes it to condense from vapor into a liquid, just as steam condenses into water in the worm of a still.

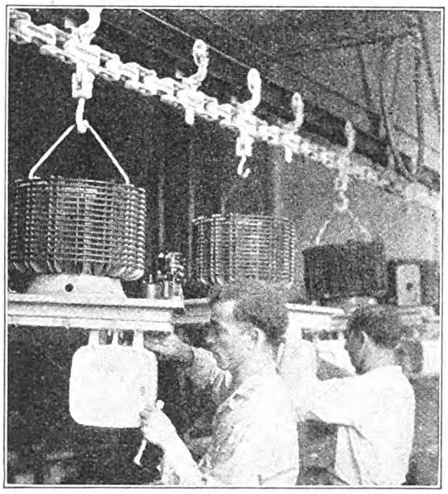
The cooled, condensed, liquid sulfur dioxide in the coil now trickles down by way of the float chamber on the right and re-enters the evaporator, to go again through the cycle we have just described.

To do all this requires energy. We do not get something for nothing. Heat will not depart from our foodstuffs without coercion. When using ice we never think of the energy aspect of the matter, possibly because operations involving energy usually involve motion, and ice is immobile. It takes place there, nevertheless.

THE compressor unit consists of the motor and compressor, together with the main frame on which they are mounted. This assembly is mounted on three vertical springs in order to reduce to a minimum the transfer of any noise or vibration to the outside casing. The motor is of the single phase induction type. It is very simple and has no brushes or sliding contacts, so it does not interfere with radio reception. The rotor of the motor is pressed on the main shaft.

The compressor is of the single oscillating cylinder type. As the piston is moved in and out by the action of the crank pin, the cylinder is made to oscillate about its trunnions. The cylinder rides on the bearing plate and its oscillation opens and closes the suction port. This oscillation also operates the oil ports. The compressor operates at 1750 revolutions per minute, which is the rated speed of the motor. One of the unique features of this unit is that it never requires re-oiling after it has left the factory. A permanent supply of high-grade mineral oil is placed in each unit at the factory and, since this oil is never overheated, it cannot become mixed with dirt, and it cannot oxidize or evaporate; there is, therefore, no need to replace it. A simple force feed supplies all moving parts with a liberal quantity of this oil.

In this oil bath is immersed a small 10-watt electric heater usually called the "oil conditioner." Nearly everyone is familiar with the inefficient operation of an automobile when first started on a cold day. Maximum efficiency is not obtained until the motor and oil reach the proper temperatures. The oil conditioner in this refrigerator is connected to the power supply whether the motor is running or stopped. This heating unit maintains the oil at a temperature which will give maximum efficiency of operation at all times, and under all conditions. The average cost of operating the oil conditioner is approximately one cent per day, but the increased operation efficiency of the unit which is effected by the use of the oil conditioner practically offsets the very small cost of the current it consumes.



THE CONVEYOR LINE

Here evaporators are being cleaned before they are coated with a special lacquer

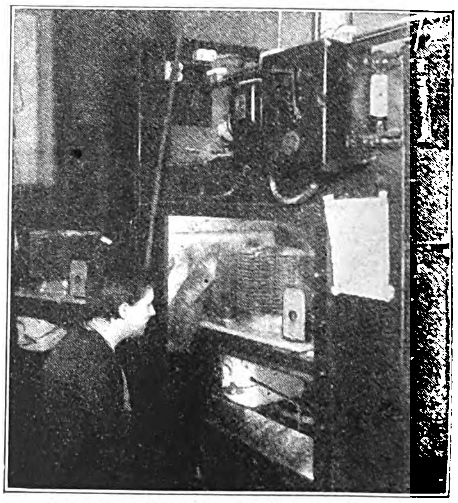
The heart of an electric refrigerator is the motor and the automatic control which regulates the flow of power into the motor. The control must be just as positive in its action as any other part of the unit. The one used in this refrigerator performs the following distinct functions:

1. Gives automatic control of the operation of the motor to maintain uniform cabinet temperature.
2. Allows manual control of unit operation.
3. Protects the motor against overload.
4. Acts as a starting device for the motor.

The control also has an accessible temperature adjustment which permits the user to obtain any desired cabinet temperature within the recommended range. All of these features are combined into one simple control which represents an invaluable engineering accomplishment.

The steel casing which covers the compressor unit is drawn in two operations. Sheet-steel fins are line welded to the outer surface of this case. The steel fins serve the double purpose of providing surface for the dissipation of heat and form a support for the copper condenser tubing. This casing is bolted to the drop-forged base of the unit by means of 18 bolts. A tongue and groove joint with a lead gasket is used to make this connection absolutely tight. All parts of the unit which are required to hold vapor under pressure are designed with a minimum safety factor of 20.

THE evaporator is very interesting from a design and production standpoint. It is made of three drawn steel sections nested together to form two compartments. The inner compartment is for the refrigerant, while the outer compartment is for a freezing solution which acts as a cold storage. An air-tight joint between the steel shells at their open end is made by hydrogen brazing and atomic welding. In the brazing process the joint to be brazed is first made mechanically tight. It is then covered with copper oxide and a piece of copper wire is wrapped around it. The piece to be brazed is placed in a hydrogen furnace where the oxide is reduced and the copper flows into the seams, forming a solid joint. This process is especially adaptable to making internal welds. A large number of the joints in various parts of the



LOOKING FOR GAS LEAKAGE

The units pass through an ammonia testing booth. A leak produces smoke refrigerator are made by this brazing process. Costs have been reduced to a minimum by using every advantage of mass production. Presses and screw machines are used extensively in forming the various parts of the unit.

After assembly, each unit is completely evacuated and dried out before it is charged with refrigerant. After charging, each unit passes through a small enclosure and is again inspected for leaks. This enclosure contains ammonia vapor which readily detects a sulfur dioxide leak by the generation of white smoke. Then each unit is operated in a room which is held at a temperature of 100 degrees, Fahrenheit, where it must refrigerate satisfactorily. Following this test, each unit is placed on "running storage" for 24 hours as a final check before it is finally painted and shipped.

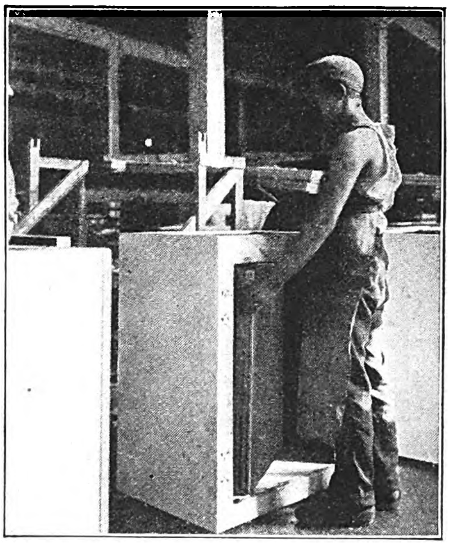
DIFFERENT as this unit is from any other ever manufactured, it was necessary for the factory to design and build many new and accurate forms of equipment to press out the steel compressor casing, evaporator shells, and cabinet parts. As a result of the demand for welding equipment to be used in the manufacture of this refrigerator, the research laboratory spent much effort developing the hydrogen copper-brazing furnaces which operate automatically and weld together the different parts. The atomic hydrogen welding process and the electric arc welding method are extensively used as well.

All individual parts, after being separately tested, are brought to the assembly line where final assembly is made. Manufacturing and factory testing are simultaneous operations because each unit is tested as the various parts are assembled. The testing of these refrigerators may be divided into two types: First, laboratory or development testing where accurate technical data on the operation and characteristics of the unit and cabinet are obtained; upon this the engineers base their final approval of any new equipment. The relative advantages of new designs or suggested improvements are here determined. Second, testing of units as they go through production to insure a uniform high quality product which meets all specifications previously prescribed.

In order to insure a high quality of product, thorough factory testing is essential. The hermetically sealed unit lends itself admirably to complete factory inspection, since it can be tested at every stage of its assembly from the time the compressor is first put together until the complete unit is in the hands of the shippers. There are 16 major tests which each unit must pass on its way through the factory.

Immediately after the mounting of the motor and compressor on the main frame, the unit is put through a half-hour test in which its general mechanical operation and quietness are checked. After this motor test, the compressor case is placed over the unit and it is then put through a second and much more severe test. This consists of pumping dry air against various head pressures of from zero to 200 pounds per square inch, continuous readings being taken on recording instruments. This test gives a check on the volumetric efficiency, power input and starting torque of the motor, and the operation of the unloader. With 200 pounds per square inch pressure in the case and condenser, a submergence test is made on the complete compressor unit in order to determine if there are any leaks. Various intermediate and high potential tests, control tests, et cetera, are made until the unit is finally assembled and charged with the refrigerant.

One of the primary essentials of a successful electric refrigerator is proper cabinet construction. In fact, a good refrigerator cabinet is equally as important as a good refrigerating unit, since the function of the unit is to remove heat from the cabinet and the function of the cabinet is to preserve the cold created within it. Years of research and experiment uncovered the pitfalls in many assemblies, and disclosed the advantages of other newly designed features which appeared to be unconventional at that time. The all-steel refrigerator cabinet represents a great advance in cabinet design. It is as radical as the change from wood to steel Pullman cars, or as the change from wood to steel bridges.

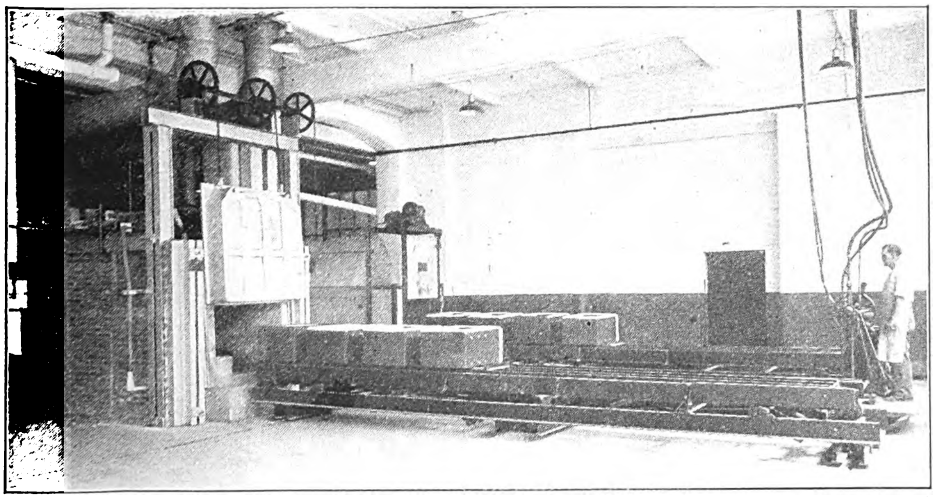


APPLYING HEAT INSULATION

Heat insulation is placed inside refrigerator cabinet before the innerlining

THE cabinet consists of an outer shell of heavy steel. The bottom is crimped in by a 600-ton hydraulic upsetting press making practically a water-tight joint. Within is the inner steel liner with bottom plate electrically line welded to the walls to form one piece. The space between the walls is filled with insulation and the opening around the door is fitted with black "textolite," specially developed for this use. The all-steel construction permits hinges and self-closing latch being bolted onto the steel walls, eliminating any possibility of the door sagging and insuring the proper door seal.

The interiors are finished with three coats of vitreous porcelain enamel baked and fused to the steel in automatically controlled furnaces. Exteriors are finished with a specially perfected process. Finally, the cabinet is crated and travels on its separate way to meet the refrigerating unit at the time of installation in the customer's home.



ENAMELING INSIDES OF CABINETS

Electrically heated vitreous enamel furnaces are used to fuse the enamel. Three coats of enamel are baked on. The heat is so great that the operations are controlled at a distance

¶ *Enough steel wire to wrap six times around the earth at the equator will go into the cables of the new Hudson River Bridge. A coming article tells how this wire is manufactured and how it is shipped to the job.*

The Great Flint Mines of Grime's Graves

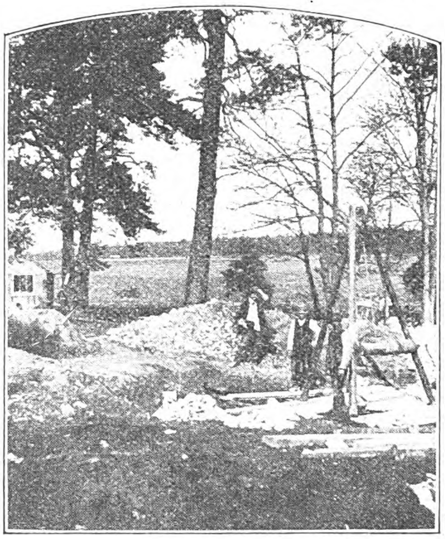
How Ancient Man Sank Deep Pits in Solid Rock, in Search of Suitable Flint for His Implements

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland; Past-president, Prehistoric Society of East Anglia Vice-president, Suffolk Institute of Archeology and Natural History

(All illustrations by permission of the Prehistoric Society of East Anglia)

THERE are few more beautiful parts of East Anglia, in England, than the widespreading heath lands of northwest Suffolk and southeast Norfolk. Here, in a splendid undulating country, the heather and gorse grow in profusion, while stately clumps of Scotch pine trees stand silhouetted against the sky. In the ancient past this area must have been greatly favored by prehistoric man, for in it have been found immense numbers of flint implements of different ages, many of which lie scattered about upon the surface of the dry and sandy soil. The country is very sparsely populated at the present day but occasionally may be seen the tower of a grey and weather-beaten church, or the chimneys of some manor house which for many centuries has been occupied by a long succession of English land owners.



ONE OF THE PITS

Figure 1: Rigging erected over a pit by the Prehistoric Society of East Anglia

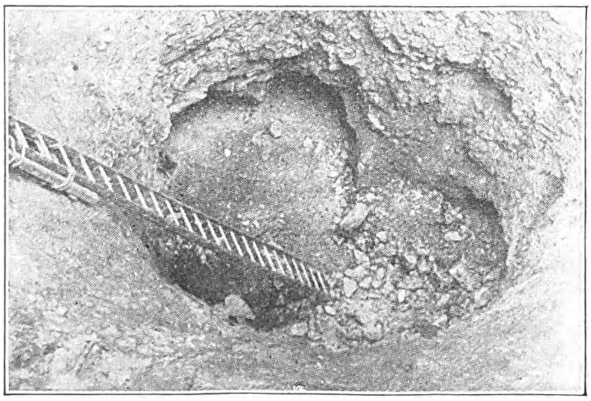
IN a remote and not easily accessible part of this attractive country, and set in the middle of far-stretching heath lands, is a place of great interest to those who make a study of prehistoric humanity. For here our ancestors of the Stone Age mined in the chalk for flint, and although many of their workings have in the course of time been obliterated, there are still to be seen several hundreds of cup-shaped hollows which we know to be the partially filled-in shafts sunk by the ancient miners.

It is only, however, in recent years that the real significance of this place has been understood. Indeed, the state of ignorance formerly prevailing about it is clearly indicated by its name. "Grime's Graves" would, in fact, almost lead to the conclusion that here various members of a family named Grime were buried, but such is very far from being the case. The name was evidently first given to the place by the Norse invaders of East Anglia, because Grimm is a Norwegian water-sprite. When these people came upon any site which presented to them unusual and unexplainable features, they named it after their particular fairy. Thus in England there are ancient camps still called Grimspound, and similar names, while the prehistoric mines we are considering were styled "Grimm's Graves," a name which in the course of time has become altered to that by which we now know it.

Grime's Graves occupy a position on the plateau of southwest Norfolk, where the white chalk is covered by a considerable thickness of sand and glacial boulder clay. At a depth of about 30 feet from the surface of the ground, and embedded deeply in the underlying chalk, is a layer of very fine flint, and it was this material which was exploited by prehistoric man.

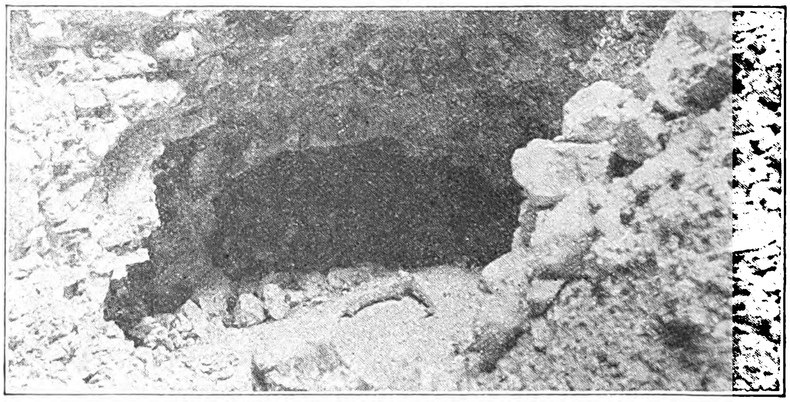
NOW, it would be no very easy task, even with modern appliances, to sink a shaft 30 feet deep and about the same width at the mouth, through the soft upper strata and into the chalk at Grime's Graves; and when it is realized that this was accomplished in early times solely by means of deer-horn picks and flat bones used as shovels, we are filled with amazement at the pertinacity and skill of those who carried out this stupendous task. When, also, it is seen that the prehistoric miners, in going through the sand and clay, made their shaft with a good slope to prevent slipping of the sides, it becomes evident that these people were by no means novices at this work.

The Prehistoric Society of East Anglia has opened two of the pits at Grime's Graves, and by so doing added greatly to our knowledge of this important site (Figure 1). It was evident from the diggings carried out, that a shaft had been sunk from ground level down to the layer of the desired flint, which was removed over the area covered by the base of the pit. After this was done lateral galleries were driven at right-angles to the bottom of the shaft (Figures 2 and 3), and by



LOOKING DOWN INTO A FLINT PIT

Figure 2: The ancient pit after it was cleared of debris. Mouths of lateral galleries show at bottom

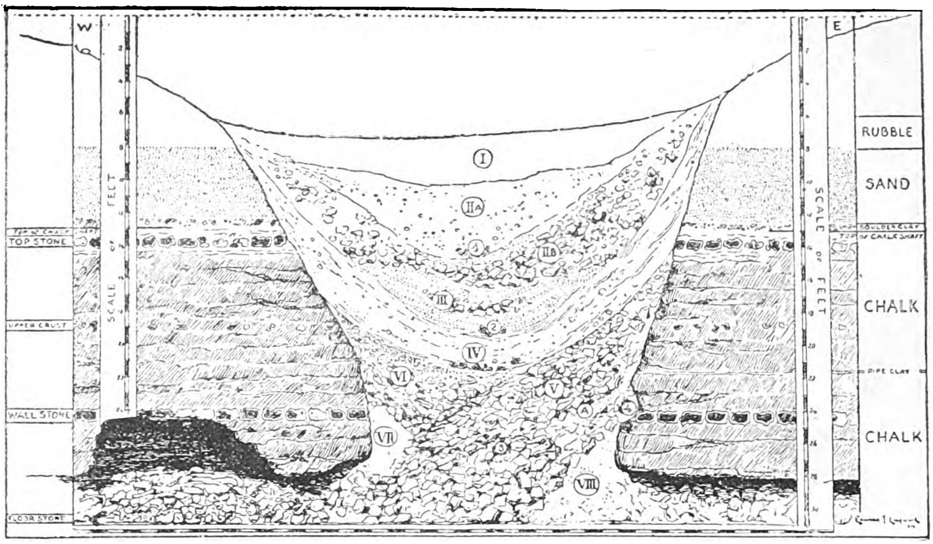


AT THE BOTTOM OF THE SAME PIT

Figure 3: In the center is a deer-horn pick left by one of the ancient miners. It is not so inefficient an instrument as one might suppose before using it

this means a further considerable amount of the "floor-stone," as it is called, was recovered and hauled to the surface by means of thongs and probably some kind of primitive baskets. Upon being brought to the surface the flint was flaked with quartzite and other similar hammerstones to the desired forms. Thus around the edges of many pits large workshop sites have been discovered, and these have yielded an astoundingly large number of implements and flakes.

The shafts of the mines were found to be filled with alternate layers of rainwash and material excavated from other pits (Figure 4), and as remains of hearths were found deep down in the filled-in material it is evident that these places served as dwelling places from time to time.



SECTION OF ONE OF THE PITS BEFORE CLEARING OUT

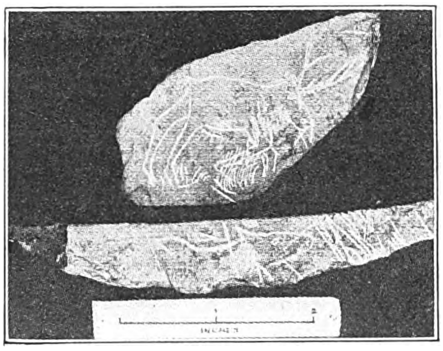
Figure 4: When the debris of the centuries was cleared out it was discovered that the pits had later been used as dwelling places. Various layers of loose in-filling are depicted

THE work carried out by the Prehistoric Society of East Anglia was under the direction of S. A. E. Peake who, since these initial excavations, had undertaken many others at Grime's Graves. A great deal of digging has also been conducted there by by P. V. Leslie Armstrong, who has made a number of very interesting discoveries relating to this immense *atelier* or workshop of prehistoric times.

Ever since the problem of Grime's Graves was first approached by Canon Greenwell, a well known English archeologist who opened one of the pits in 1875, it had been imagined that the ancient work carried out at this place had been accomplished by Neolithic man. But, in the course of the more recent excavations it has become clear that, although some of the implements found in the pits and in the workshop sites surrounding them are certainly of types usually believed to be referable to Neolithic times (Figure 6, at left) other specimens, shown in the same figure, as clearly seem to point to having been made in the Mousterian-paleolithic epoch; that is, the epoch of Neanderthal man.

The matter has been somewhat cleared up by the work of Mr. Armstrong, who has found that in places at Grime's Graves three superimposed floors are present, and that the most ancient of these contain implements of paleolithic types; while in the more recent and later levels, specimens of Neolithic form are discovered. He has also unearthed certain flints from the lowest level which bear upon their unflaked crust, or cortex, spirited outlines, evidently made with a sharp flint, of various animals (Figure 5.)

This is indeed a remarkable discovery, as never before have implements of Mousterian form been found associated with artistic productions of this kind. It is, in fact, well to realize that if the implements of paleolithic type found at Grime's Graves are indeed of paleolithic age, then we must recognize that in those remote days mining for flint was in vogue, and an artistic sense well developed. Some investigators hold, however, that the Mousterian-like specimens are really of Neolithic age, and that their discovery points to the recrudescence of ancient forms of implements at a period much later than that in which they were generally made.



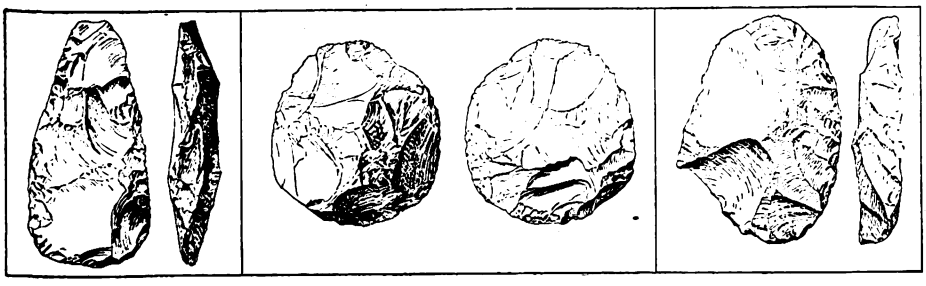
. NEOLITHIC, OR OLDER?

Figure 5: Neolithic times in western Europe began roughly at 8000 B.C., and ended about 3000 B.C. Both dates vary

IT is true that no bones of any extinct animal have yet been found in the excavations at Grime's Graves, and this fact seems to militate against assigning a paleolithic date to any of the implements there found. But it must be remembered that the area yet to be investigated is very large, and much more must yet remain to be discovered regarding the age of the various industries at this place.

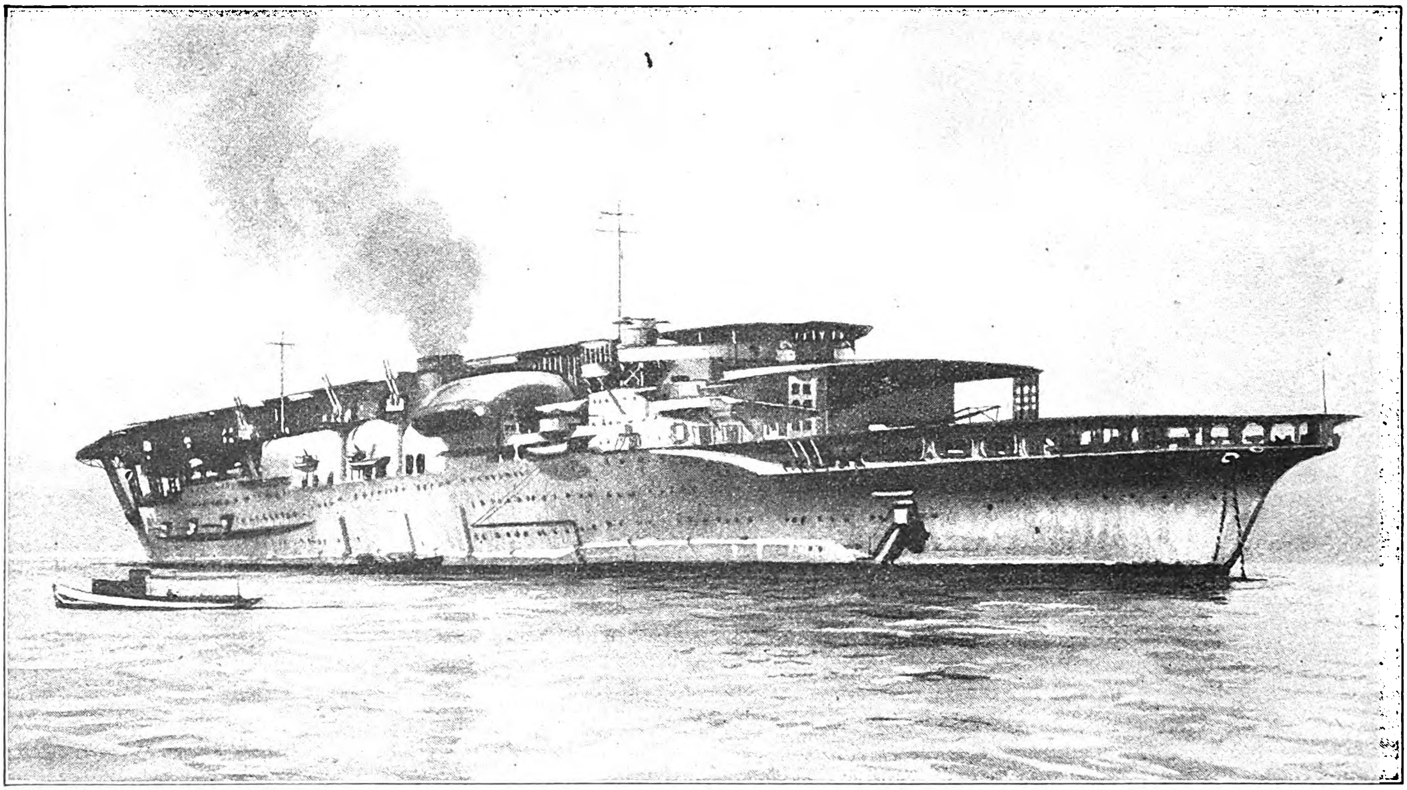
One of the problems confronting those of us who have investigated Grime's Graves was to understand how the ancient miners knew that a suitable layer of flint was to be found at a depth of 30 feet from the surface of the ground. In carefully thinking this matter out I came to the conclusion that the floor stone must outcrop somewhere near at hand, and that this outcrop was discovered and followed up to the high ground by the Stone Age people. I decided, further, that in a shallow and now dry valley, which runs close to Grime's Graves, trial holes would probably reveal more ancient workings than those upon the plateau—and this conclusion has been found to be correct. Mr. Armstrong has, in fact, found, in close proximity to the valley, a series of very archaic pits which are obviously much more primitive than those hitherto opened. These are approached by rough steps cut in the chalk.

The work of exploring Grime's Graves is still being actively prosecuted. As it goes on it is being realized that this site is one of the most remarkable prehistoric areas at present discovered in England.



IMPLEMENTS OF DIFFERENT AGES, FOUND AT GRIME'S GRAVES

Figure 6: At left, two elevations of a Neolithic artifact; center, hand ax of Mousterian type; right, a side scraper of Mousterian type. All are shown about one fourth natural size



All illustrations from drawings by the author

AIRCRAFT CARRIER "AKAGI"

Originally launched as a 42,000-ton battle cruiser which was condemned by the Washington Treaty to be scrapped, this ship was rebuilt into the carrier as shown. Of the two funnels on the starboard side, one bends downwards while the other just clears the flight deck

Japan's New Navy

Quietly, and Without Publicity, a Great Battle Fleet Is Being Constructed on the Opposite Shores of the Pacific

By DR. OSCAR PARKES*

Joint Editor, "Jane's Fighting Ships"

IN view of the possibilties of further naval discussions between the United States and Great Britain regarding limitations or reduction of their naval armaments, it is worth while turning to the other side of the Pacific and taking stock of the great fleet which Japan is steadily amassing. Year by year her authorized programs are regularly passed into service without cruiser construction being dropped or postponed as in the British Navy, and owing to the secrecy which obtains with regard to the design of new vessels of all classes, no publicity is accorded to the extraordinary development in her cruiser squadrons and destroyer and submarine flotillas which has taken place in the last year or so.

Prior to the World War, the Japanese modeled their designs more or less along British lines. There was a certain absence of originality in layout and the influence of foreign construction could be traced in every class of ship from battleship to submarine. Nowadays that is all changed. A glance at the illustrations which accompany this article will show that Japanese constructors have struck out along entirely new lines and, so far as profile is concerned, are producing warships as bizarre as those which left the French dockyards in the nineties. And their singular appearance is a very good index to their unique fighting qualities, for in one way and another their designers have managed to incorporate really wonderful all-around qualities in their ships.

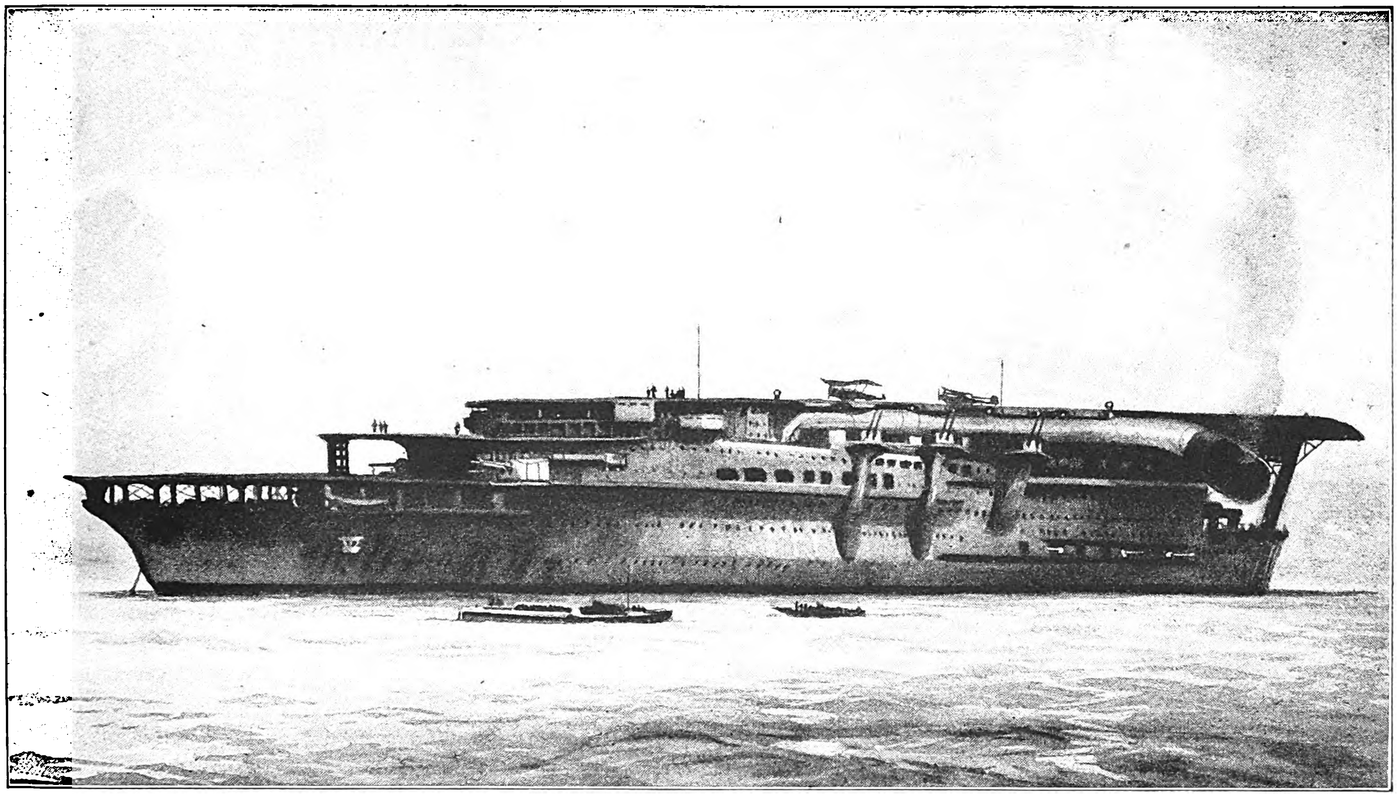
TURNING first to the aircraft carriers, we find in the *Akagi* and *Kaga* the Japanese reply to the American *Saratoga* and British *Furious* classes. Until 1927 Japanese constructors were allowed to attend the Greenwich school of naval architecture in London and so reaped the benefit of the accumulated experience enjoyed by the British in this type of ship, thus enabling them to incorporate in their own designs the best features of British practice.

In a general sort of way both ships resemble the *Furious*, but are a deck higher, and tackle the furnace exhaust problem differently. Neither was designed as a carrier *de novo*, the *Akagi* having been launched as a 42,000-ton battle-cruiser and the *Kaga* as a 39,900-ton battleship which, in each case, was condemned to be scrapped under the Treaty.

As in the case of the *Saratoga* and the *Lexington*, the hulls were appropriated for conversion into carriers and the *Akagi*, which was launched in April 1925, was completed during last year. She is 763 feet long between perpendiculars, 92 feet in beam, and draws 21¾ feet at her normal displacement of 28,100 tons. The hull proper is flush-decked with a marked sheer towards the stern, but the deck levels are generally so confused that it is impossible to follow them with the eye. On the forecastle is a flight deck leading into the main hangar which runs aft to the main deck gun positions. Along the topside of this deck amidships, are the three anti-aircraft gun positions, on each side of which twin 4.7-inch guns are mounted, making 12 in all. These are carried out boldly

---

*See "Among Our Contributors," page 373.

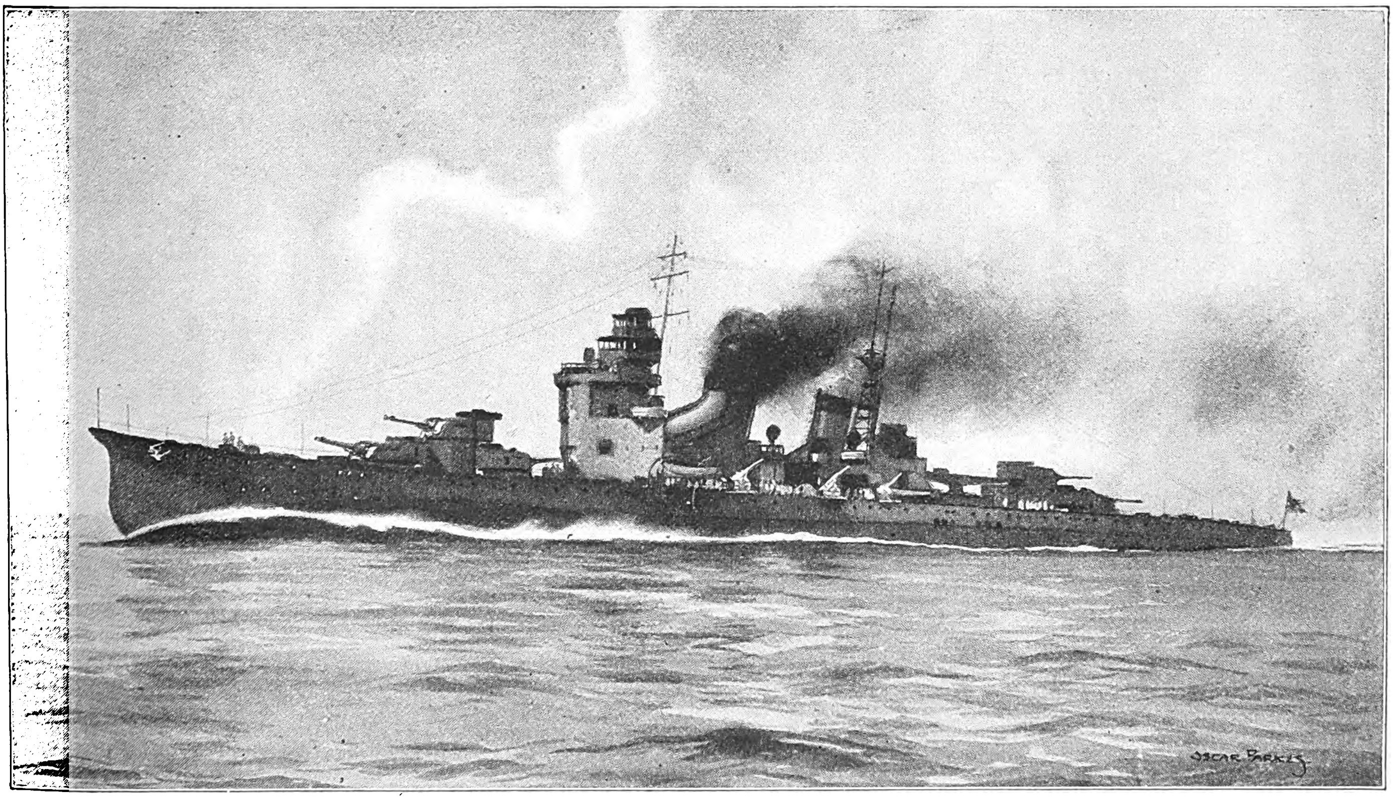


AIRCRAFT CARRIER "KAGA"

This ship was launched as a 39,900-ton battleship but its use for that purpose was condemned by the Washington Treaty. It has many unique features, not the least of which is the arrangement of the funnels. A funnel on each side carries the smoke aft and downwards

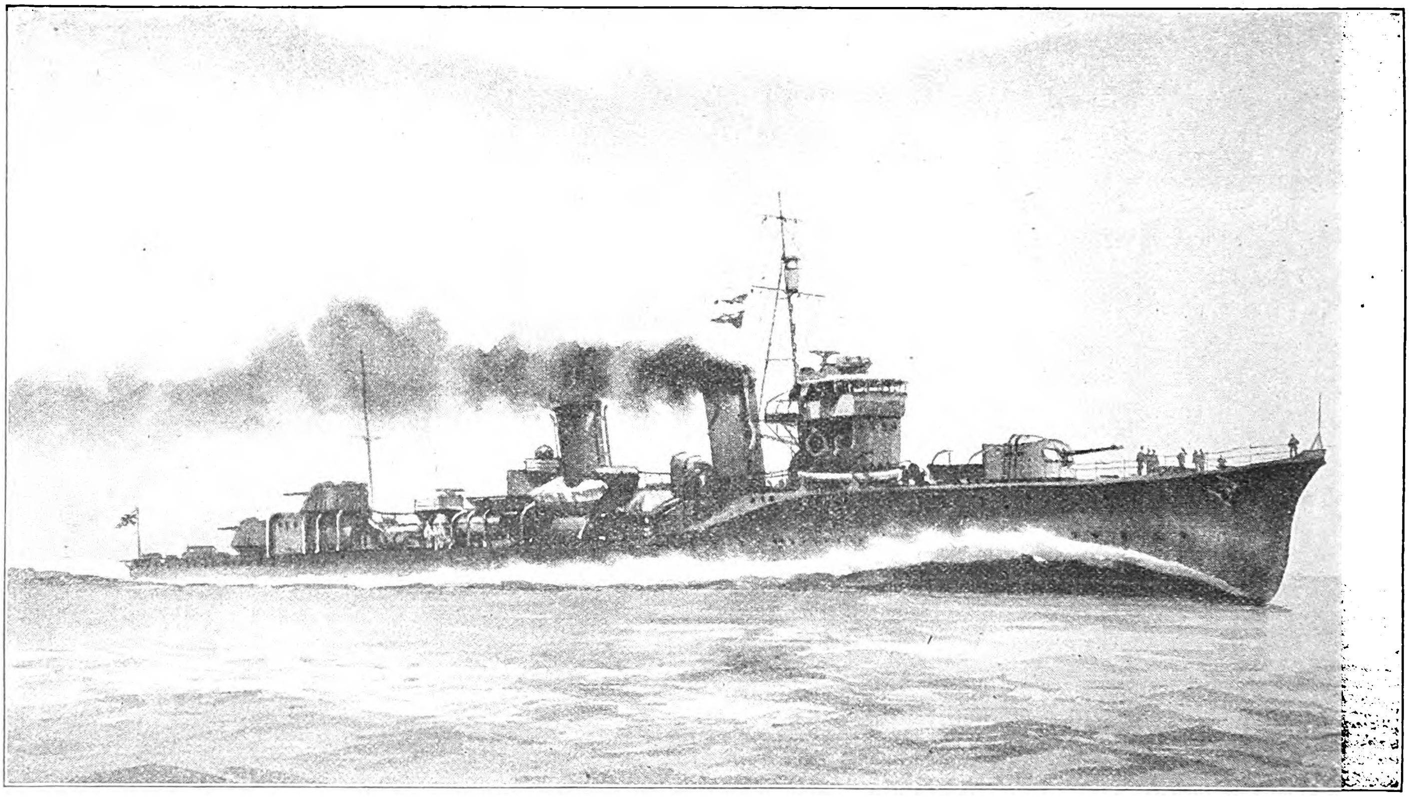
from the ship's side on sponsons giving a sky arc clear of the flight deck, and seem far more happily placed than in the *Furious* class. Surmounting the hangar is the main flight deck which is carried out on trussed supports at the stern to give ample landing space.

The main armament of 10 eight-inch guns is disposed rather curiously. At present only three guns are mounted on each side along the main deck towards the stern—a position which restricts their command above sea level and limits their employment to one side only. As the ship is designed, a turret containing a pair of eight-inch guns should be mounted on each side forward under the end of the superstructure, and it is understood that these have recently been put aboard as shown in the illustration. Along the water-line, there is an armor belt extending from under these guns to the after positions, but the thickness



10,000-TON CRUISER "NACHI"

The most powerfully armed of any of the Treaty cruisers. She carries 10 eight-inch guns, six 4.7-inch anti-aircraft guns, and twelve 21-inch torpedo tubes. Her profile shows that her hull has not a single straight line above water. Note wavy deck line and double curved bow



DESTROYER "FUBUKI"

The most powerful destroyer yet designed. Twenty-four of this class are either built or building. The *Fubuki* has a peculiarly cluttered-up profile, the lofty bridge being, perhaps, the most conspicuous feature. Ships of this class seem fitted to deal with any contemporary

of this is a secret with the Japanese.

When designed for 42,000 tons, her geared turbines of 131,200 horsepower allowed for 28.5 knots speed, but at her present displacement this should be considerably exceeded and well over 33 knots is probably nearer the mark. The smoke problem has been dealt with in an original manner, there being two funnels on the starboard side, the foremost of which is carried downwards and outwards over the superstructure while the second one just clears the height of the flight deck. The idea of these is that when the ship is under weigh, the turned-down stack should be used during flights so that smoke and fumes will be discharged clear of the approach to the landing deck, while the second stack would be employed for screening and at sea.

It has been reported that the idea is not entirely a success and that some alteration to the stacks, as in the *Kaga*, is to be made. The arrangement does not seem particularly happy when steaming with the wind on the starboard side as the fumes would be blown against the side or over the decks, and impair visibility. The *Akagi* has a small conning tower under the end of the flight deck forward, with range finders and searchlights on small sponsons along the top.

The *Kaga* is a smaller type, is shorter and beamier, being 715 feet between perpendiculars, 102¾ feet in beam, and, with the same draft, her nominal displacement is 28,100 tons as in the *Akagi*. The design is very much along the same lines but she is easily differentiated by the curious elephant trunk smoke-stack on each side which runs from just forward of amidships to right aft where it is splayed out and downwards. In this arrangement the leeward stack would be used during flights so that all furnace exhaust would be borne away from the flight approach if, as it is supposed, all the furnaces can be discharged into either stack. In the British *Furious* and *Argus*, the exhaust ducts are fitted with blowers and an arrangement of water screens over the vents to prevent the wind from interfering with smoke ejection, but in neither of the Japanese ships do these appliances appear to be fitted.

The *Kaga* has a most curiously angled hull side and the three pairs of 4.7-inch anti-aircraft guns on each beam are carried out on great curved pedestals to clear the flight deck, which has a decided upward slope towards the stern where it is borne outward on a single pillar on each side. The quarter deck is short compared with that of the *Akagi* and is likely to be extremely uncomfortable at sea if both funnels have to be used. The main armament is the same as in the *Akagi* and disposed in a similar manner

Both ships will carry between 50 and 60 planes, but owing to the secrecy which has been observed over their construction, nothing whatever is known as to their internal arrangements.

As a 39,900-ton battleship, the *Kaga* was designed to steam at 23 knots with her ship horsepower rating of 91,000; now she is reported to be able to reach 25 knots. Each ship carries only two light masts for radio.

According to the present opinion as to the best size for carriers, these ships are far too big and are not likely to be very successful as flight platforms. Airmen seem to be agreed in preferring a carrier with a funnel as it enables them to judge the proximity of the deck with greater certainty, and it remains to be seen whether the alternative schemes in stacks, as tried out in these two ships, will prove to be better than the big starboard funnel adopted by the American, British, and French navies.

No bolder innovation in cruiser design has been seen for many a long day than the *Kako*, which was completed in 1926; and the 10,000-ton *Nachi*—first of a class of eight "Treaty" cruisers—is the logical development of this 7000-ton ship to Treaty limits. There is the same flush-decked hull of sinuous outline, the towering mass of bridge-work and mast combined forward, and light tripod aft, the curiously trunked funnels with a marked rake, and the quaint superstructures dotted with box-like searchlight and rangefinder platforms. But instead of six turrets, in groups of three fore and aft, with a single eight-inch gun apiece, the *Nachi* carries five larger gun-houses, each containing a pair of eight-inch guns giving an axial fire of four, and a broadside of 10 guns. Amidships she mounts six 4.7-inch sky guns with 12 21-inch torpedo tubes in groups of three above water. She is, therefore, the most powerfully armed of any of the Treaty cruisers. Her dimensions are: length 630 feet, beam 57 feet, draft 86½ feet.

The hull is triple shelled and specially designed to give the utmost possible protection against under-water attack, with water-line and augmented deck armor over the engine and boiler compartments for 410 feet amidships. This water-line belt is three to four inches thick and extends from the base of the third turret to just abaft the fifth, while the thickest deck armor is five inches. The turrets have six-inch faces and are apparently far more substantial than those mounted in other Treaty cruisers. If all this armor has been worked into the ship as reported, it is little short of wonderful that a ship horsepower rating of 130,000, giving a maximum speed of 33 knots and a deep load speed of 32 knots, should have been provided with a fuel capacity of 2000 tons of oil. The *Nachi* seems to lack the high freeboard of ships of the British *County* class with their magnificent accommodations and decks eight feet and more in height, and gives one the impression of being a sinister fighter of infinite possibilities. The wavy-line design of her hull is unique among the navies of the world.

It is understood that the *Nachi* will carry four planes, the hangar being abaft the main mast with a catapult between this and the fourth turret.

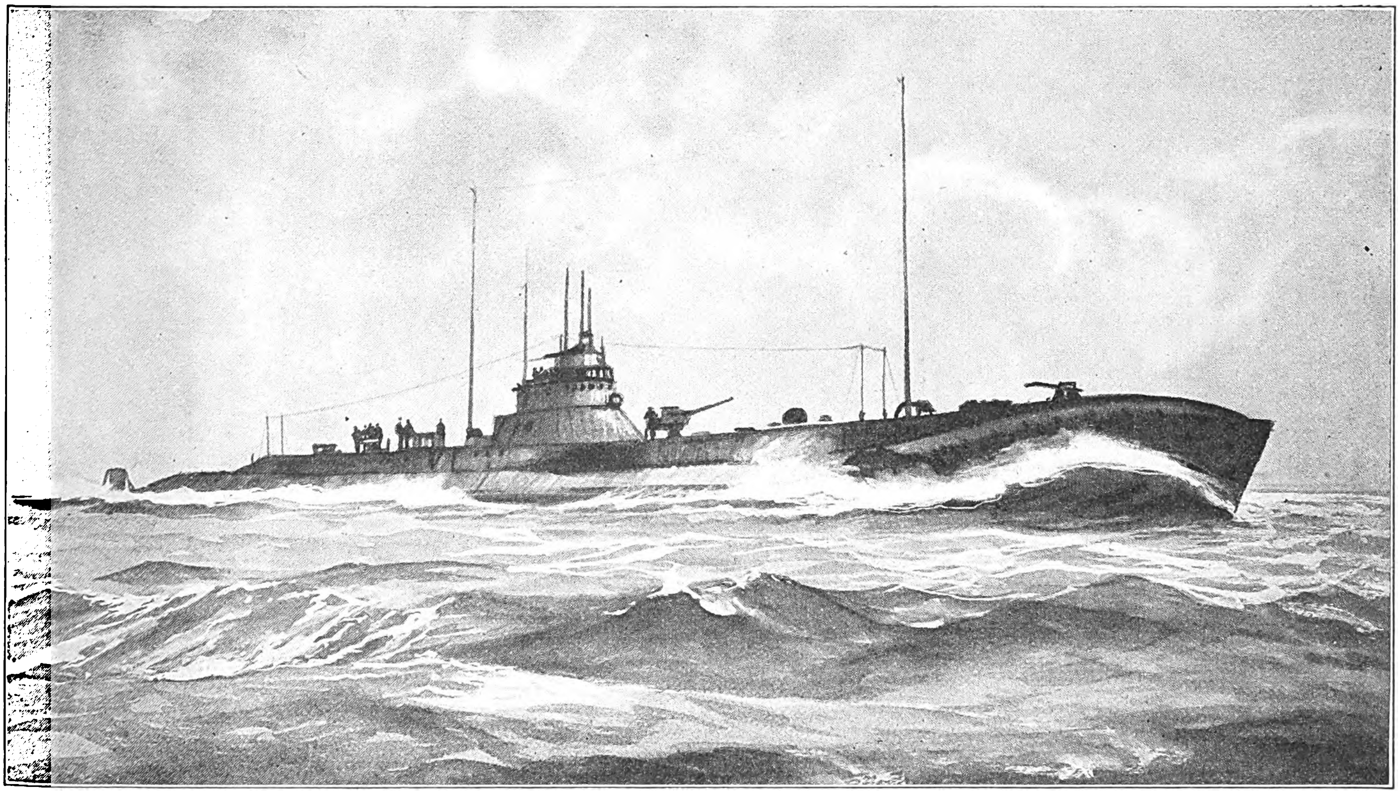
Of this class, the *Nachi* was completed at the end of last year; the *Myoko*, *Ashigaro*, and *Harugo* are now finishing and on trials; the *Atago* and *Takao* will be ready in 1930 and the *Chokai* and *Maya* the following year.

IN the *Fubuki*, Japan has produced the most powerful type of destroyer yet designed, and 24 vessels of her class are built or building. On a displacement of 1700 tons—1850 full load—they carry an armament of six 4.7-inch and two sky guns, with nine 21-inch torpedo tubes. Unlike previous practice which has favored guns disposed singly, the *Fubuki* carries hers in pairs inside large roomy gunhouses, one on the forecastle and two aft, all having very wide arcs of fire. The torpedo tubes are in triple mountings, one set being raised well above deck level between the funnels, and the other two fore and aft of the rangefinder platform amidships. With a rating of 45,000 ship horsepower, the designed speed is 34 knots. In appearance she presents a peculiarly cluttered-up profile, the bridge being lofty, with a light tripod mast after the French fashion. Note the boats carried on the forecastle, the big ventilating cowls athwart the fore funnel—these have disappeared from all destroyers since the war—and high freeboard forward. These boats appear particularly well fitted to deal with any contemporary, and carry an armament which would have been considered suitable for a light cruiser in the not so very distant past.

The German submarines which were allotted to Japan at the end of the war prove to have been a very decided factor in the design and development of her under-water craft. In the "I" types of large ocean-going boats, the influence of the *U-125* is very apparent. Although this boat was destroyed according to arrangement, numbers *I-1* to *I-5* are exact copies of her, and subsequent numbers are variations in one way or another. The boat shown, *I-63*, recently completed, is a fine all-around type displacing 1659 tons on the surface and 2200 tons submerged, the dimensions being 320 by 25¾ by 16 feet.

Forward of the conning tower is a 4.7-inch gun with a three-inch sky gun aft, and the torpedo armament consists of eight 21-inch tubes. The horsepower of her Diesels is 6000, giving a speed of 21 knots on the surface, the motors for submerged cruising allowing for 10 knots. A very large cruising radius—about 16,000 miles—is attributed to boats of this type, and they are supposed to be capable of crossing the Pacific and back without re-fueling.

The hull is somewhat reminiscent of the older British "K" class except that the cut-water is straight. Earlier boats of this type were fitted with a net cutter at the bows, but this has now been removed.



SUBMARINE "I-63"

In designing her submarines, Japan studied the German U-boats which were allotted to her after the war. The result is that her "I" type submarines distinctly show the German influence. The "I-63" is said to be capable of crossing the Pacific and return without refueling

The Puzzles of the Comets—I

Why Comets Shine; Why the Heads Appear to Contain Different Substances. These and Other Puzzles Are Being Solved

By HENRY NORRIS RUSSELL, Ph.D.
Director of the Observatory and Chairman of the Department of Astronomy at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

FROM antiquity to the present day wide interest has invariably been aroused by the appearance of a bright comet. In olden times this happened mainly from fear that the comet was a dire portent of coming evil. But even this groundless superstition has been of real service to science in later centuries, for the ancients' accounts of comets are remarkably accurate and complete. This is proved by the fact that written records remain of every one of the 27 returns of Halley's Comet since 85 B.C.

Though these fears are now happily allayed, comets have still a strong hold upon the public interest, and this is entirely reasonable. They are undoubtedly the most romantic bodies known to astronomy. They appeal not only to the eye and to the reason but to the imagination.

First of all they have the romance of the unexpected. A majority of all observable comets, and all the conspicuous ones with a single exception, come unheralded. Sometimes they sneak in, one might almost say, on the far side of the sun and are not detected until they have grown brilliant.

NEXT, though there is good reason to believe that comets are not really newcomers but have visited the sun before, the periods which intervene between these visits are long and add to the romantic feeling. Halley's Comet, for example, the only bright one which has been seen at many returns, takes just about a human lifetime to complete its circuit. When again it appears a few old people remain who can remember seeing it as children more than 70 years before. The remaining bright comets, with periods ranging from a few centuries up into the hundreds of thousands of years, impress the imagination in a different way and make the whole sweep of recorded history seem small.

There are a score or two of comets, to be sure, which return at frequent intervals, but these are all faint and are of interest mainly to the professional student. Yet even these are often elusive. A comet was discovered, for example, in 1928 by Forbes at Cape Town and followed for a month by accurate observation. This sufficed to show that its orbit was elliptic and its period about 28 years. It then appeared that the same comet had been seen twice before—in 1818 and 1873. The observations of the earlier date are only rough estimates and in the latter year it was not followed long enough to permit the determination of its period. But, calculating back from the present time, Dr. Crommelin has proved the identity beyond question. At the intermediate return in 1845 and 1901 the comet was farther from the earth and got by without notice. When next it comes in 1956 we will know where to look for it in the sky and it is particularly certain to be seen again.

Courtesy Yerkes Observatory

HALLEY'S COMET 1909-1910

This shows the discarded part of the tail drifting away from the comet, due to the pressure of the sun's light

But it is not only in such ways that comets seem to be the erratic members of our system. Their changes in form and brightness are still more remarkable. We know just where to point our telescopes toward Halley's Comet at any time, but for 75 of the 77 years of its circuit it is utterly invisible. As it last approached the sun it came into sight first as a tiny hazy patch when some 500,000,000 miles away. When 200,000,000 miles away it was still a rather inconspicuous telescopic object. At perihelion 50,000,000 miles or so from the sun, it was a glorious object with a head as bright as the pole star and a tail that stretched far across the sky. Then, as it receded it faded and shrank till within a year it had utterly disappeared.

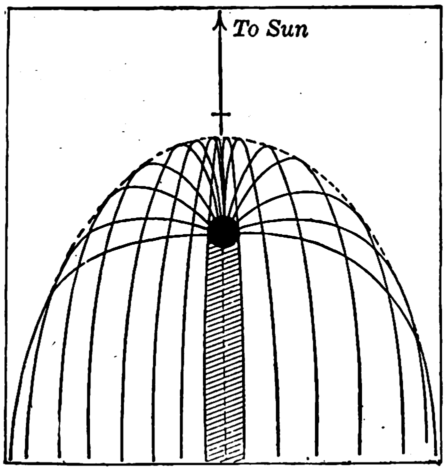
These extreme changes arise partly but not mainly from changes in distance from the earth. Could we sail through space along with the comet, keeping our distance, we would still find differences in its appearance. As it approaches the sun it grows larger as well as brighter and the tail forms, sweeping into space on the side away from the sun and lengthening until it may extend for 50,000,000 miles or more.

We know now that these changes arise from the expulsion of material from the main part of the comet, which is driven out into the surrounding space and then vigorously repelled by the sun.

SOME of this stuff shines by its own light and reveals itself spectroscopically as a mixture of familiar gases, carbon compounds, cyanogen, carbon monoxide and nitrogen. The rest reflects ordinary sunlight and is probably some sort of exceedingly fine dust. We are pretty sure what drives the gases and dust away from the sun. It is the pressure of the sun's own light upon the minute particles of dust and still tinier molecules of gas. But what drives them out of the comet's nucleus to begin their journey, no one has even guessed. Considerable forces must be at work, for the speed of their ejection is often apparently high. But we simply do not know what they are. Until recently it was unknown, too, why certain gases and these alone did the shining, and why carbon and cyanogen should be in the head but not in the tail, and carbon monoxide in the tail alone. But this has been cleared up by recent work.

Study of the complicated band spectra of these gases has shown that the "tail bands" are given out by carbon monoxide only when the molecule has lost an electron and become ionized. Such an accident may happen to an atom or molecule by the action of short-wave ultra-violet light which the sun doubtless emits strongly, though our atmosphere keeps the rays from reaching the earth's surface. In the head of the comet, though the gases must be excessively rarefied, there may still be some chance for an ionized molecule to pick up an electron, but in the tail where the density is infinitesimal there can be no chance of this. So the presence of ionized molecules in the latter is not surprising.

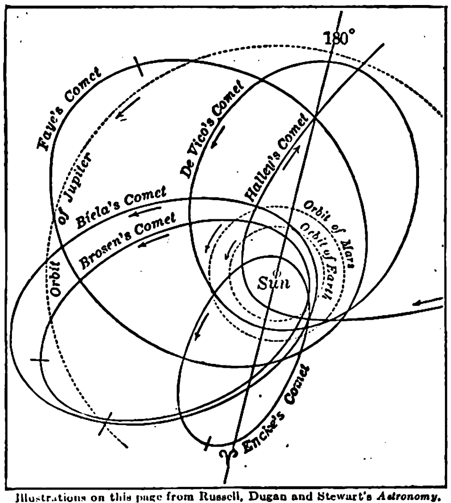
But why does not the neutral carbon monoxide show in the head? The physicist answers again: strong bands in its spectrum are in the far ultra-violet where we can not see them through the blanket of air above us. Just the opposite is true for cyanogen. Here the neutral molecule has strong bands in the accessible region and the ionized one has none (if indeed an electron can be pulled out of this particular molecule without breaking the atoms apart) and we should expect to find the bands in the head and not in the tail.



HOW TAILS ARE FORMED

The material is first expelled sunward from the nucleus, then repelled by light

Why these molecules shine has also become clear. They absorb energy from the sunlight and unload it again in bright line radiation. This is just what the gases of the sun's atmosphere do. The latter are so thick that the absorption is heavy and produces unfamiliar lines of the solar spectrum, but in a comet's head the gases are so thin that they do not absorb light enough to produce visible lines—as was proved when Halley's comet passed right in front of the sun in 1910. But when this amount of light, small indeed in comparison with that of the sun's disk, is let loose in all directions and we see it against a dark moonless sky it is visible enough; though moonlight suffices to drown out most of it. The calculations of Zanstra show that the observed brightness of comets can be fully accounted for by this process of "resonance" and one puzzle is thus solved.



Illustrations on this page from Russell, Dugan and Stewart's *Astronomy*. Courtesy Ginn and Company.

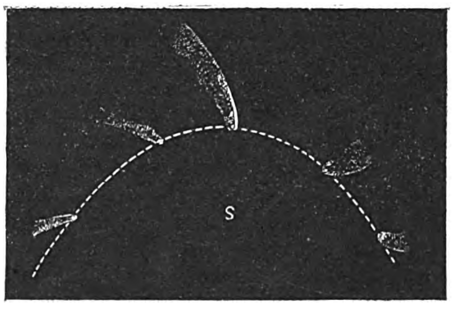
SHORT PERIOD COMETS

All are relatively faint, few being visible to the naked eye, and most have no tails

Many minor problems remain. The strongest of all the radiations of the comet's head come from the molecule C_2—two atoms of carbon joined to each other and to nothing else. Such an affair deserves the appellation that someone has given it of a "very lonesome molecule." It must be highly unsaturated, with a strong tendency to combine with almost anything else that comes along. Indeed this is the very reason why it shows its presence in our spectra, for the ordinary respectable "saturated" molecules of the familiar gases are hard to break apart or even to stir up, consequently they do not absorb any sort of visible light but only light in the remote ultra-violet. But the unsaturated molecules, which are easier to dissociate or to excite, absorb light in the visible region.

THESE unsaturated carbon molecules show their spectrum in the familiar Bunsen burner in the laboratory. Here the molecules of hydrocarbons are being broken up and oxidized and it is natural to find the fragmentary debris of the process. But what breaks up the gases of the comet's head? Though we know the fragments are there we can not answer.

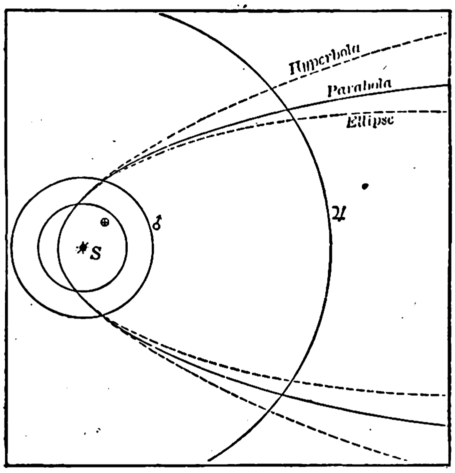
Of one thing more at least we can be sure. There may be, indeed in all probability there are, many more kinds of gas in the comet's head than our spectroscopes reveal. If we could only establish an observatory upon the moon, outside the ozone-laden layers of our upper atmosphere, we could then observe the short waves of light which would give us the decisive tests and might extend our analysis greatly.



"SNAPPING THE WHIP"

The tail trails the head only when it approaches the sun. Later it "crawfishes"

Meanwhile we may note that the gases which are known to be present are familiar enough. Their names are household words, but even by the uninitiated they are recognizable as the ogres rather than the good magicians of the fairy tale of chemistry. We all know that cyanogen and carbon monoxide are poisons of the deadliest sort. Does this bring back something of the old fear, and suggest that comets after all may be dangerous neighbors? While talk of this sort has broken out from time to time there was a great deal of it when Halley's comet came near in 1910 and the earth was due to pass through its tail. The tail, to be sure, was exceedingly rarefied but even so, the earth, if it drove through a million miles of it, might at the highest estimate pick up a hundred tons or so of cometary gases. A hundred tons of poison sounds terrifying but this would be spread over the hundred millions of square miles of the front hemisphere of the earth and would give about one ounce of poison gas, if it were all poison, to every 30 square miles.



SPECIES OF ORBITS

Near the earth the three types nearly coincide, making discrimination difficult

Now above a square mile of the earth's surface there are nearly 30,000,000 tons of air. To put 1/30th of an ounce of poison into this would not be alarming, particularly as it is put in at the top of the atmosphere a hundred miles above our heads.

It is no wonder, then, that when the earth actually passed through this comet's tail nothing at all happened.

¶ *Next month Dr. Russell will conclude his discussion of comets, with especial attention to the spectra of the head and tail, examples of which will be shown with lines of the elements he discusses.*

Press a Button—There's Your Book

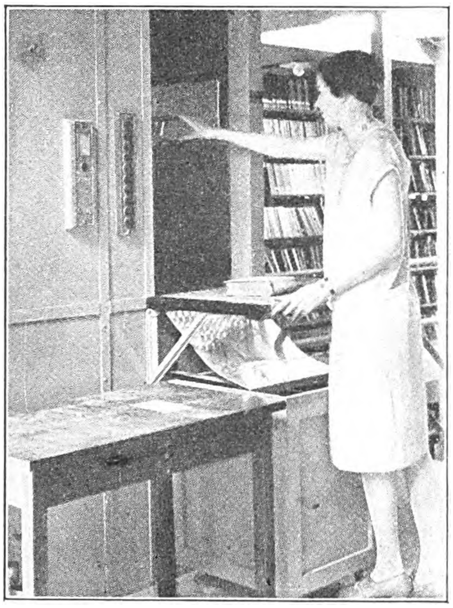
Mechanical Carrier Speeds Up Delivery of Volumes From Library Shelves to the Reader

By CLARE ELLIOTT

TIME was when books and those who read them were regarded with awe. In the early days of printing, each volume was tethered to its case by a heavy iron chain, and those who were scholarly enough to be able to read a book had to travel to some center of learning and consult a chained library.

But along with the democracy of silk stockings, tile baths, and autos-for-all, books have become an everyday necessity and today the tendency is toward making them as convenient and quickly available as any other popular commodity.

Looking for new worlds to conquer, American designers and engineers recently invaded the cultural field, bringing about many radical changes. Now, the up-to-date library will do practically everything but read your book for you. It will house your most obscure treatise in a 20-story steel book tower, will preserve its life by scientific heating and cooling systems, will locate it on request within a few seconds, and deliver it to you on an automatic distributor almost without human handling.



LOADING THE CARRIER

The books are placed on the cars by attendants, and point of delivery fixed

That is what American ingenuity has done with the chained library of medieval days. That is what American inventiveness is doing in the world of education, carrying over into the most scholarly of professions the same efficient systems which have made American businesses so remarkably successful.

At the recent convention of the American Library Association in Washington, Mr. William Snead, vice-president of a century-old firm of book-stack engineers, announced that a new automatic book-distributor which "may revolutionize library planning" has just been perfected and will shortly be installed in four libraries under construction in widely separated parts of the United States and Canada.

This invention, patents for which are now pending, will be the feature of libraries at the University of North Carolina, at Rochester University, at the University of Cincinnati, and of the Toronto Public Library. It represents the outgrowth of 20 years' study on the part of library designers and is the last word in mechanical perfection in this "Push-button Age." As the inventor himself describes it, "All the brains are in the machine."

Thirty or thirty-five years ago, a book-conveyor designed to operate in both directions was installed in the Library of Congress at Washington, but the return-book feature of the system was so cumbersome that it was discontinued and now is used only as a one-way device to deliver books to the main desk. Similarly, in the New York Public Library different models have been tried out, but none has previously answered all of the librarian's requirements.

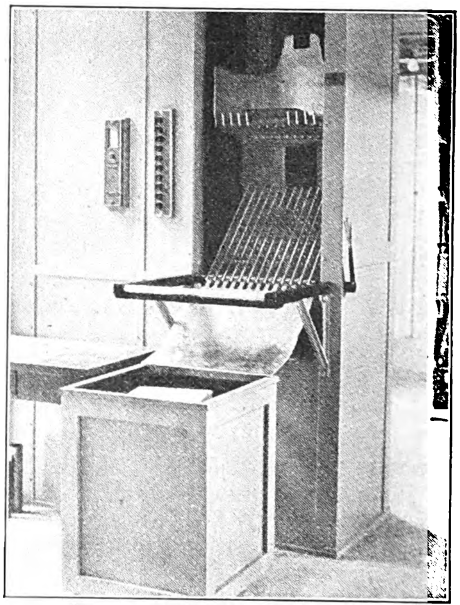
THE features of the new distributor which set it high in the list of reliable new inventions are that it operates in two directions; conveys books horizontally, vertically, and around corners; has distant control; is made to discharge books automatically at any given point; contains a number of ingenious safety devices; and is constructed so simply that it does not get out of order.

The two-way book distributor consists of an endless chain running continuously down the stacks, beside the main delivery desk, and back up the stacks. Carriers eight feet apart convey the books to their destination where an almost humanly intelligent comb arrangement takes off at each tier only the books in cars directed to that floor, and slides them gently into a padded compartment.

This cushioned box contains a spring bottom which sinks with the weight of deposited books. Should books continue to pile up, unremoved, the sinking bottom rings a bell when the box has become two-thirds full, announcing to attendants that the receiving capacity has been reached.

Books may be loaded on carriers going either up or down, but they are taken off by the automatic comb only on down cars. If a wrong button is pushed, it can be automatically corrected by pushing the proper button. A repeat button is also provided so that all carriers can be sent to one floor if desired without the necessity for directing each car individually.

The cost of operation is extremely small. At the University of North Carolina, the entire system will run by a three quarter horsepower motor at a cost of from one to two cents an hour. At the Rochester University Library, which will have the tallest bookstack tower so far constructed—20 stack stories in height—the operating cost will be only three or four cents an hour.



DELIVERY

The aluminum-fingered comb rises automatically and removes books from car

Each carrier will hold as many as six or eight books 12 inches by 16 inches in size, lying flat, or it will take a large folio 16 inches by 24 inches standing on a slant.

In fact, the new system will probably have as much fascination for the ordinary layman as a new building excavation or a safe-hoisting job. Readers in the four libraries mentioned will doubtless be grouped six deep around the delivery desk for the first few months!

Here's what they will see. Suppose that the librarian at the main desk desires to deliver a book to the 6th stack floor. As he places the book on a passing carrier, he pushes button number 6 which also releases a small red metal flag on the car. This target bears the number 6 so that attendants on other floors can see at a glance that that particular car is in use and know to which floor it is destined.

When the basket arrives at the 6th floor, an aluminum-fingered comb automatically rises and combs off the book into the padded box below, returning immediately to its horizontal position forming a convenient table. Meantime, the flag has dropped down, making the carrier free again for books going to other floors or back to the main desk. And all this without the presence of an attendant!

Similarly, books requested at the main desk are placed in cars by attendants from every stack floor in the tower and automatically delivered to the reader with true American speed.

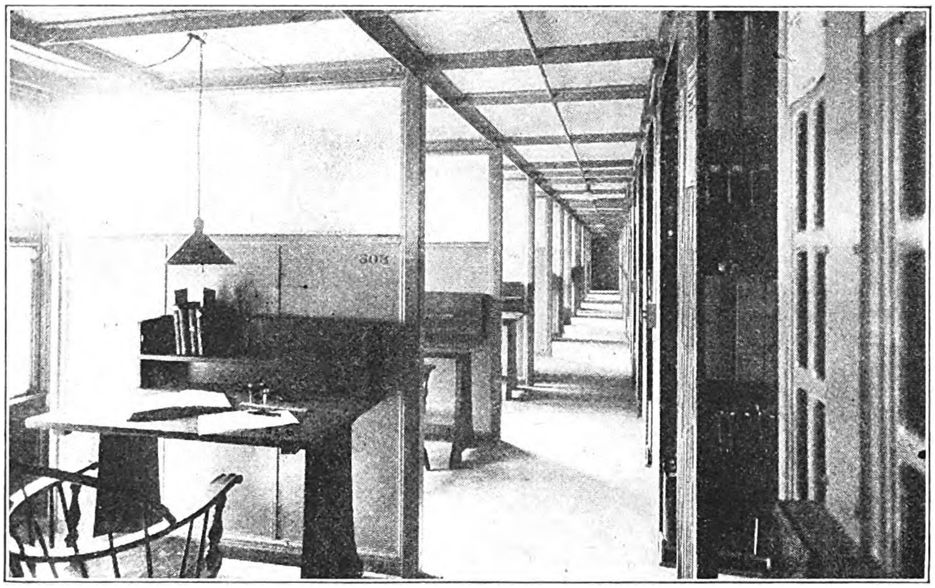
According to Mr. Snead, "The longest time required to deliver a book to the main desk from the most distant point in the tallest stack via the distributor is under four minutes. This is in great contrast to many of the great European libraries where a reader is required to put in a request for a research book one day and return for it the next. It also speaks well for our business-like file systems, since many of our large libraries contain over a million volumes.

"Service could be speeded up, if desired, by putting the carriers three feet apart instead of the usual eight feet, and gearing up the system to top speed. The distributor can be adjusted to run from 50 to 100 feet a minute.

"The new distributor will not only increase the speed of service in new libraries, but will be a boon to librarians who must work in out-of-date buildings erected 20 or 30 years ago, in which reading rooms and storage spaces are now overflowing with books, but which are architecturally incapable of expansion. The new mechanical system makes it possible for additional bookstacks to be built away from the main library—across the street or even on some inside block of land which, lacking street frontage, is useless for other purposes.

"The necessity for a flexible program of expansion has been proved by a recent statistical study which we have made of college libraries. This shows that, with ordinary growth, the number of volumes is doubled every 20 years. For this reason old library buildings, not constructed to take care of this inevitable expansion, must find some outlet for their rapidly growing book collections."

Another influence of American engineering efficiency, translated into terms of absorbing knowledge, may be seen in the new study cubicles now being built in many college libraries immediately adjoining the stacks. This arrangement divides a large bookstack tower into a series of small libraries, with all books pertaining to one subject grouped together. Such cubicles have been found very successful at Dartmouth, the University of Michigan, and in the Widener Memorial Library at Harvard.



STUDY CUBICLES IN COLLEGE LIBRARY

This method of construction provides a quiet place for study, near the required reference books, and enables the student and serious research worker to concentrate in comfort

By this method the student is placed near the volumes he requires, is enabled to have greater quiet for serious study, and is permitted to keep his research books at hand from day to day, thus saving attendants' labor and continuous handling of the books.

The space allotment for each reader in an ordinary reading room has been estimated by library experts at about 30 square feet. When only large, general reading rooms are provided, with ceilings from 15 to 30 feet in height, each reader occupies from 450 to 900 cubic feet of library space.

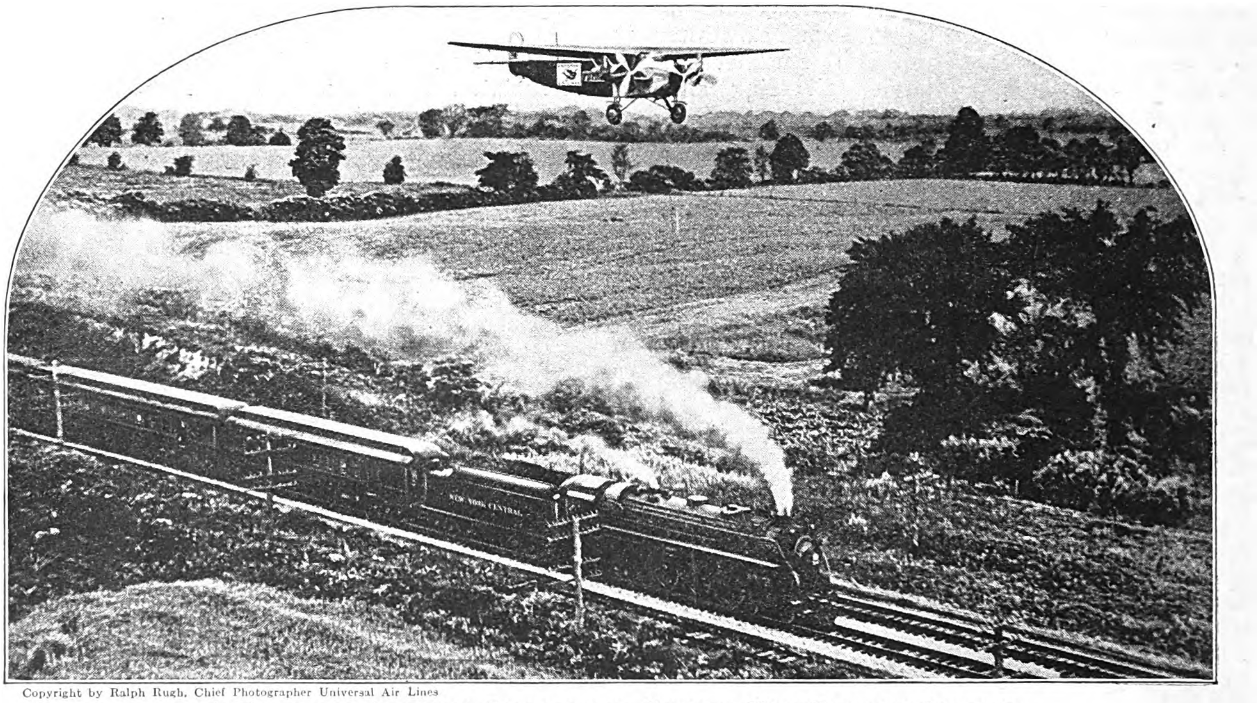
The study cubicle principle for serious readers cuts down this allotment enormously. Each student occupies only about 20 square feet in a stack tier 7½ feet high. Thus but 150 cubic feet per reader is required, a saving of from two thirds to five sixths of the space, with incalculable improvement in comfort, convenience, and concentration.

The heart of every great library, sentimentally as well as financially, is in its rare book section, and with increased public interest in books, their values, in terms of rare editions and original manuscripts, have skyrocketed. Many are as valuable and as eagerly sought as rare gems. But even here, the modern trend is not to keep these treasures locked away from the student, but to make them readily available. Ours is a practical appreciation of fine things. No book at any public or college library is too precious to be used and consulted by any authorized student.

At the New York Public Library, only glass doors and devoted attendants guard such treasures as one of the Gutenberg Bibles, first of all printed books (dated about 1455); four copies of the First Folio Shakespeare, seven copies of the Second Folio, eight works printed by William Caxton in the 15th Century, and the Bay Psalm Book, first book to be printed in the territory now comprising the United States, at Cambridge, Massachusetts, in 1640.

Beyond the simple rule that no cleaners can enter the rare book suite of three rooms without a member of the staff being present, there are no complicated regulations or guarding devices necessary. The ancient and invaluable Gutenberg, a copy of which sold at auction for 106,000 dollars, stands in its place beside several hundred others also issued in the first century of printing, all ready for instant use.

At the Congressional Library in Washington, to which a copy of every book copyrighted in the United States must be sent by law, books which are so rare that no price can be set upon them, are consulted every day by scholars from all over the world. The only requirement is that the books be read inside one of their special reading rooms in which the reader is visible to a guard at all times through wire partitions.



Copyright by Ralph Rugh, Chief Photographer Universal Air Lines

A UNIVERSAL AIRLINER SALUTES THE FAMOUS 20TH CENTURY LIMITED

American Passenger Air Transport—II

Safety, Night Flying, Selling Aerial Transportation, and Other Phases Are Here Dealt with in Detail

By **PROFESSOR ALEXANDER KLEMIN**
Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, SCIENTIFIC AMERICAN

(*Continued from October*)

THE most important point in regard to air travel in the minds of the public is safety. To estimate this factor, one naturally turns to statistics. Owing to the comparatively recent advent of commercial flying, statistics are scarce, and what is worse, confused in character. It is not fair to group every sort of flying together. The hazards of military and naval aviation have little bearing on commercial civilian flight. Accidents occurring in unlicensed planes, in student instruction, in flying by raw pilots, in stunts, endurance, or ocean flights cannot be charged to regular air transport.

Since regular passenger travel in the United States dates back scarcely farther than the latter half of 1917, perhaps the only reliable data are the figures for 1928.

In this year, with 10,427,024 miles of scheduled flying on the air transport routes of the United States, fatalities were limited to 9 pilots and 13 passengers. This indicates one passenger fatality in something less than every 1,000,000 miles of scheduled flying. For regular passenger services over organized airways using multi-engined planes, a total of 2,200,000 miles has been flown carrying 44,650 passengers with but a single fatal accident. (This accident was a most abnormal one and was caused by the pilot of another plane actually "stunting" into the passenger plane.)

In England, over a period of three years, regular passenger services flew 3,200,000 miles, carrying 89,000 passengers, without a single fatal accident. This impressive record was only broken by a somewhat obsolete land plane, without flotation gear, being forced to alight in the English Channel.

A DISCUSSION of airplane safety would lead us far beyond the scope of this article. There is no one golden rule for airplane safety. The complexity of the subject and the number of elements which enter into its consideration are indicated by the 790 pages of papers and discussion presented at the First National Aeronautical Safety Conference in New York on October 4 and 5, 1928.

The Conference indicated the immense importance of correctly designed and located airports and landing fields and also decided that the structure of the present-day airplane may be considered adequate. Very few accidents indeed are due to structural failures in the air. However, under the score of the aerodynamics or flying characteristics of the airplane, much remains to be done. At the time of writing, a number of American and European entries are entered in the Guggenheim Safe Aircraft Competition.

The object of the competition is to secure planes which, without loss of speed or carrying capacity, will achieve slow landings and shorter landing runs; will have the ability to come into a small field surrounded by obstacles and to take off from restricted territory; will have stability or control under all possible conditions; and will have the valuable characteristic of not "stalling" or losing lift and control when flying at too large an angle to the wind. All indications are that the minimum requirements of the competition will be readily met and that a great step forward will thereby be achieved.

The safety and reliability of aircraft are even more dependent on the installation of the engine than on the engine itself. It is extraordinary what care has been lavished on such details as clean air intake for the carburetor, gasoline tanks and piping, lubrication system, ignition, et cetera. Some of the recent endurance flights have shown what remarkable progress has been achieved. With proper power installation, the hazard of fire has been largely removed. Of course, the advent of a practical aircraft Diesel engine consuming non-inflammable fuel would reduce fire-hazard to a minimum.

The use of multi-engined planes capable of functioning with at least one engine out of commission provides a decided safeguard against forced landings.

Immense progress has been made in recent years in aids to navigation—lighting, radio beacons, weather service, instruments for blind flying. Space will not permit us to discuss these aids. It is sufficient to say that the Government services, scientists, engineers, and operators are all working strenuously and co-operatively on these manifold developments, which will vastly enhance the safety of flying. Even the difficulties of fog flying will be overcome.

PASSENGER COMFORT

Wide, well-upholstered seats feature the cabin of the *Christopher Columbus*, of the Pan American Airways, Inc.

WITH their fairly profitable operations in the field of mail carrying, and with their vastly increased capital resources due to generous financing by the public, operators have attacked in very thorough fashion the questions of organization, maintenance, and ground and flying personnel. It is now customary to carry two licensed pilots on large passenger planes. In the improvement in these matters the public will also find enhanced safety.

Our lighted airways are being rapidly extended, and night flying on well-organized airways is, in the opinion of experienced airmail pilots, no more hazardous than day flying. It is true that there is a certain reluctance in the public mind to fly at night, and that the transcontinental services are arranged for night travel by rail. We believe that this is only a passing phase and that the public will ultimately be perfectly content to fly by night. There is a story *si non e vero, bene trovato*, that when Pullman was trying to organize his company, the bankers he consulted laughed at him and told him that it would be impossible to get passengers to ride on a train at night.

There are many aspects of airplane safety which it is impossible for one who is flying as a casual passenger to grasp. There are other aspects which he can readily observe, pass judgement upon, and what is more, by granting or withdrawing patronage and by personal recommendation to operators, further quite considerably.

Major R. H. Mayo, Consulting Engineer to the British Imperial Airways, gave a splendid resumé of such aspects in a paper presented before the Safety Conference.

First of all, passengers must be able to reach their particular airplane without crossing the path of other airplanes in the vicinity—a comparatively simple problem in airport management. All risk of walking into a propeller should be eliminated by suitable guards or fixtures. Passengers should not be asked to pass through the blast from a propeller. Air travelers are entitled to easy access to the cabin, through wide doors, with no climbing of slippery steps. Doors should be securely locked from the inside and pilot, mechanic, or steward should be responsible for this precaution. Major Mayo suggested that there is need for the invention of improved types of automatic locks for cabin doors.

If a passenger finds that he is roughly jolted in taxying or take-off, a letter to the company is quite in order. With the availability of oleo-landing gears and spring tail-skids, there is no excuse for jolting except on the very roughest ground. Properly fixed chairs also make for comfort. Seats should be completely padded and there should be no sharp or projecting edges on the seat ahead. A most important rule is to remain seated when the plane starts, and so remain until the airplane is well in the air.

No plane should be so designed that a passenger leaning out of a window can be injured by a propeller and passengers will do well to make sure of this.

"Can I smoke?" is a question that almost every passenger is liable to ask. Provided no part of the gasoline system passes through the cabin, and provided the cabin is constructed of non-inflammable materials, there is little danger in smoking. Smoking, of course, may inconvenience other passengers; on several American airlines the provision of a separate compartment meets this difficulty.

THERE are a few things regarding safety in a crash that prospective air travelers may like to know:

Metal construction is far preferable. Metal tubing or sections may bend, but are not likely to break and splinter.

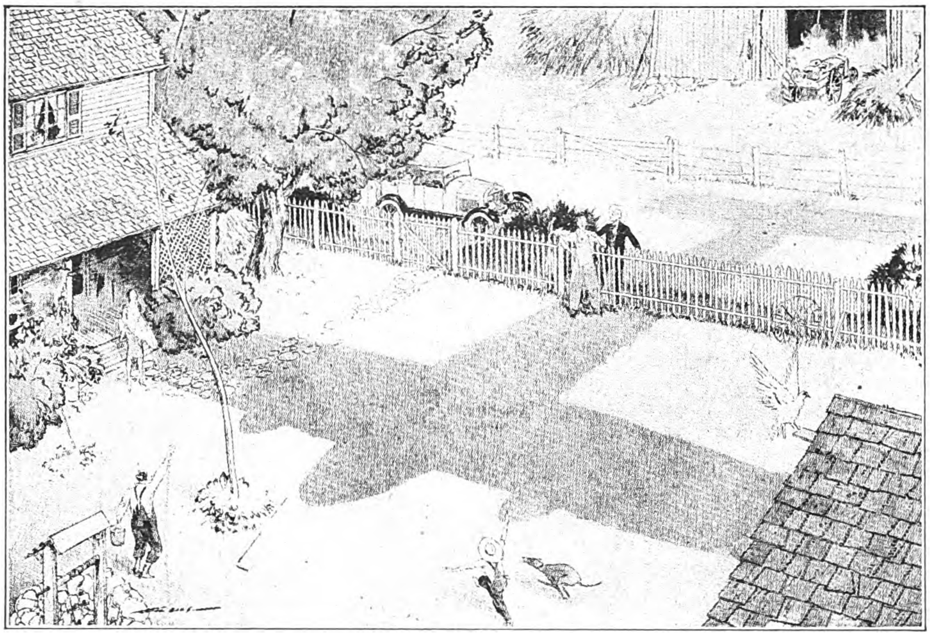
The nose of the airplane, while giving the best view, is also the most dangerous position in case of a crash. Wings, body, and landing gear all help to take up shock, and therefore a rear position in the cabin is always safer.

There should be no heavy baggage in the cabin as it is likely to fall on occupants in a bad landing. If the baggage compartment is in back of the cabin, it should be very solidly constructed.

Travelers who have been accustomed to the belts used in open cockpits may be slightly surprised that no belts are provided in a closed cabin. The reason for the difference in practice is obvious. It is only in extremely bumpy weather that belts may be helpful, and they should then be robust

WOMEN FLYERS

Right, Amelia Earhart, famous aviatrix, and Gladys McConnell, film star, who is also an enthusiastic aviation fan



LIFT UP YOUR EYES!

A striking advertisement of the Ford Motor Company, illustrating graphically how big transport companies are "selling" the idea of aerial transportation to the public

but yielding to movement by the passenger.

At least two doors are essential for a cabin carrying more than four passengers. In the case of a seaplane, an emergency exit in the roof is a necessity.

In the case of a nose-on crash, rear passengers must resist, if they can, any tendency to pile up on the unfortunate occupants in front.

Miss Amelia Earhart is of the opinion that a great deal of the business of selling aviation is being done to men alone, and that if the wife of the family does not wish the husband to fly, he usually does not fly. We believe that there is a great deal of truth in this and that is why it is so gratifying to see prominent women invited on the inaugural trips of the great transcontinental services.

FOR example, at the inauguration of the Universal Aviation Service on June 14th, Mrs. Mable Willebrandt, among other ladies, made the round trip, spending two and a half days in Los Angeles. Mrs. Willebrandt was highly delighted with the trip. Our beautiful movie stars are ardent aviation fans, and they will no doubt, as usual, set a fashion for all the young women of the country. On the Maddux Air Line from Hollywood to Agua Caliente, Mexico, 66 percent of the patronage comes from the movie stars.

The newspapers undoubtedly give aviation all the publicity it needs. Sometimes undue emphasis is placed on fatal accidents, but a fatal accident is news, and steady, safe operation is not news except when summarized once a year in an official publication.

The Ford Motor Company has had a splendid series of advertisements in the *Saturday Evening Post;* seventeen full-page advertisements have been collected in a pamphlet entitled "Lift Up Your Eyes," which is an artistic and historic document.

The Pennsylvania Railroad advertised its co-ordination with the Transcontinental Air Transport in splendid fashion by suspending a huge three-motored Ford monoplane in its New York terminal. (It would appear that officials were harassed for days by public curiosity; they were even asked whether the plane had flown inside the station.)

There is no doubt that judicious publicity and solicitation of traffic should be undertaken by every transport company. A classic example of such activity was the campaign of the Stout Air Service operating between Detroit and Cleveland, and Detroit and Grand Rapids. This included direct-by-mail advertising, small cards and folders being sent to members of clubs and civic organizations. Newspaper advertising, striking billboards, and window displays proved useful. Aerial sight-seeing tours allowed more intensive use of equipment and brought many patrons to the airlines. Subsequently, energetic efforts of this sort were rewarded by steadily growing traffic.

Our popular writers are very often enthusiastic boosters for air transport. Will Rogers has written some delightful stories about flying, and snappy sayings in the daily press, which were probably worth several million dollars of publicity to American aviation. (See page 283, October 1929 SCIENTIFIC AMERICAN.) Some writers let their pens run away with them in witty mockery of air travel. To anyone interested in the real sights of Europe, restaurants, cafés, and rathskellers, we heartily recommend Karl K. Kitchen's unconventional book, "Pleasure if Possible." He complains of not being able to smoke, of missing lunch, of the company of an airsick passenger. But separate smoking rooms *are* now provided on our planes, luncheon *is* served on board and airsickness is rare. Karl does confess that he wrote his humorous notes while flying from Munich to Vienna, and that he didn't hit a single rough spot or air-pocket. Karl had plenty of time on his European travels, and so he concluded that he would travel by train henceforth. Let him have an urgent business trip in view from New York to Hollywood, for example, and we are very sure he will be a convert to one or the other of the transcontinental air services.

IF we have to meet the queries and objection of our friends regarding air travel, we find the best policy is to tell them the truth and nothing but the truth. Air travel is far from having reached perfection, but it is certainly safe enough and pleasant enough for any real American, man or woman.

The interviews of celebrities after an important flight are a poor guide to what the public thinks of passenger

By air
to Cleveland
in 100 minutes
DETROIT-CLEVELAND AIR LINE
ENCLOSED CABIN • Operated by STOUT AIR SERVICE Incorporated • SUPER-COMFORT

BILLBOARDS SPREAD THE WORD

Aerial transportation companies must advertise if they are to do business commensurate with their investment. Here is shown a sign erected by the Stout Air Service, Inc.

flying. It would require a trained psychologist and immense effort to secure an approximately correct cross-section of opinion.

They are very pleased with the generally comfortable way in which a bus or taxi brings them to the airport, and the minimum of inconvenience with which they are guided to the plane.

They get a little impatient sometimes when the pilot taxies to the far end of the airdrome to head into the wind and have a long clear run.

THEY are apt to worry about dizziness and airsickness, and to be too tense. Unexpected bumps are likely to be very disturbing to them. They like to walk around, to look at the instruments, to ask questions. Scenery, no matter how beautiful, ceases to be of interest after an hour or so. Noise and confinement make people nervous.

Hence there should be, in day flying, a stop and a chance for a walk every two or three hours.

Some passengers are disappointed because they get no thrills. Ladies are pleased because there is no dust or dirt. They like the fact that the plane is cool in summer because of the altitude, and warm in winter. They enjoy the meals served aloft. They like to sleep in the comfortable inclined chairs. The majority still considers flying an adventurous and hazardous experience.

We believe that careful and regular operation, custom, and above all, time are required before the public will accept air travel. That they will accept it, eventually, is a matter of not the slightest doubt.

We believe that one of the most important things in flight operation is to keep the passenger thoroughly informed of the progress of the flight. Following frequent European practice, we believe that every cabin should contain an air-speed indicator and an altimeter to show height, as well as maps or handy cards such as shown in our illustrations. Maps with some degree of pictorial representation are recommended, from which the passenger can follow the progress of the trip. Some American companies follow this practice. Others, such as Stout and Colonial, also supply newspapers or magazines or both. The Maddux Airlines have found that occasional air travelers have difficulty in following maps and have installed loudspeaking units in the plane. The pilot picks up the transmitter, snaps on a switch, and gives the passengers interesting and clear information.

Where a steward is aloft, he should be intelligent enough to give the passengers all the information they need. If two pilots are carried, an informal occasional visit from one of them should be very agreeable. Officers on board an ocean liner gladly assume such duties.

In general, the more passengers understand flying the more secure and interested they will be. In line with this idea, we find in the folder of the West Coast Air Transport Company the following instructive remarks:

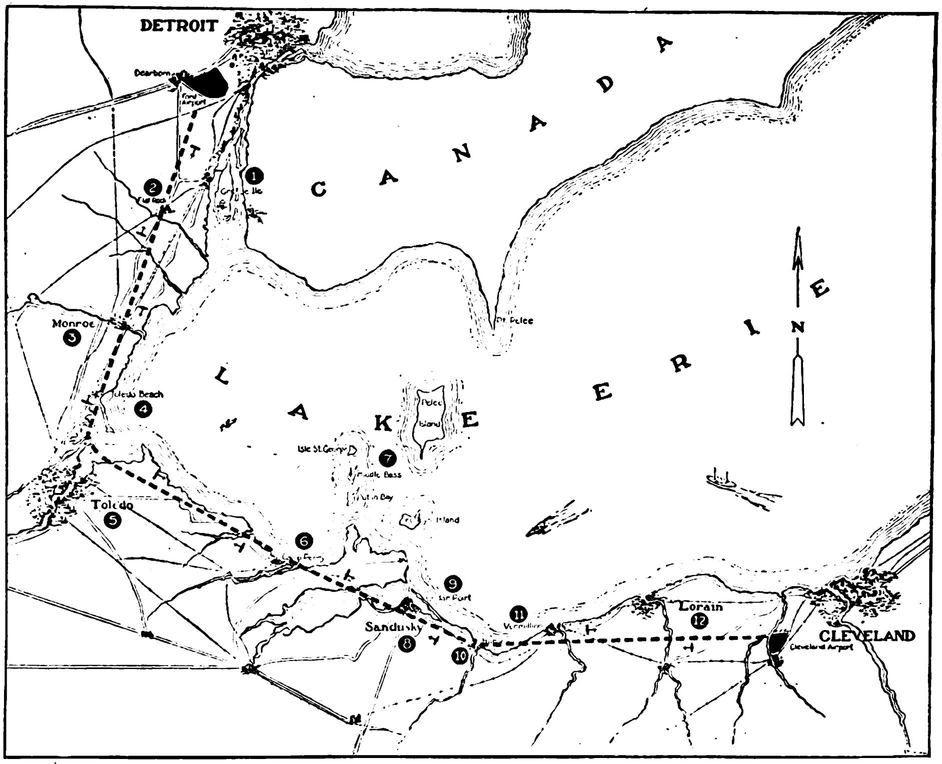
"An airplane always starts and lands head against the wind. After a small run, the machine almost imperceptibly rises from the ground. Air pockets do not exist, and when 'bumps' occur, they are caused by upward and downward currents of air which have a similar effect upon airplanes as waves have on ships. Dizziness as experienced by some people when looking down from a high building is unknown in flying, as there is no connection with the earth. In descending, the engines are always shut off. In turning, when an airplane is in flight, the machine banks, one side is raised above the horizontal and the other lowered. This is a perfectly normal movement and indicates that the aircraft is under full control."

IF to these remarks had been added the statement that in certain localities and under certain atmospheric conditions, bumpiness may result without endangering the safety of the plane in the slightest degree, the air passenger would have all the "Theory of Flight" that he needs.

In the literature of Stout Air Service, we find some equally sage advice. The following in particular, some air travelers will be glad to have:

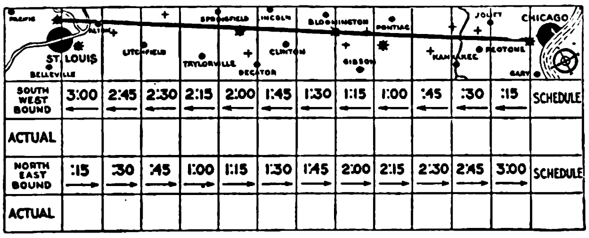
"Some people have ears that are sensitive to the slightest change in air density at different altitudes. If so, swallow once in a while or breathe a

(*Please turn to page* 455)



KEEPING THE PASSENGER INFORMED

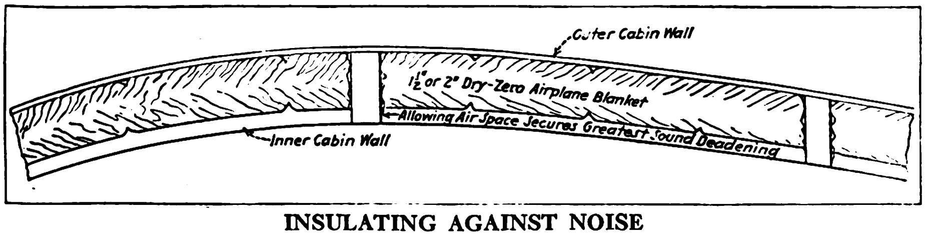
Stout Air Service, Inc., distributes these informative maps to passengers on their lines, so that they may follow the progress of the ship as it speeds along on its scheduled route


ST. LOUIS
BELLEVILLE
LITCHFIELD
TAYLORVILLE
SPRINGFIELD
DECATOR
LINCOLN
CLINTON
BLOOMINGTON
GIBSON
PONTIAC
KANKAKEE
JOLIET
PEOTONE
GARY
CHICAGO

SOUTH WEST BOUND	3:00 ←	2:45 ←	2:30 ←	2:15 ←	2:00 ←	1:45 ←	1:30 ←	1:15 ←	1:00 ←	:45 ←	:30 ←	:15 ←	SCHEDULE
ACTUAL													
NORTH EAST BOUND	:15 →	:30 →	:45 →	1:00 →	1:15 →	1:30 →	1:45 →	2:00 →	2:15 →	2:30 →	2:45 →	3:00 →	SCHEDULE
ACTUAL													

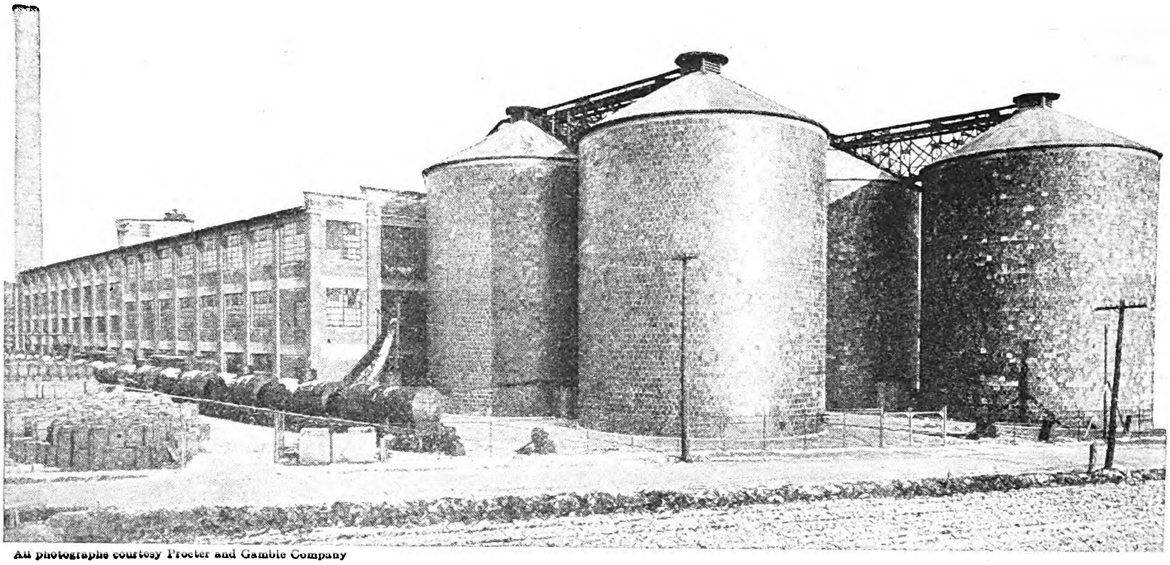
AN AERIAL "SCORE CARD"

Passengers on Universal system planes can check the scheduled time against actual flying time on this card


Outer Cabin Wall
1½ or 2" Dry-Zero Airplane Blanket
Allowing Air Space Secures Greatest Sound Deadening
Inner Cabin Wall

INSULATING AGAINST NOISE

By the use of the material known as "dry zero" in construction such as this, it is possible to insulate cabin planes against much of the noise from the engines and the propellers



Copra (chopped cocoanut) comes from the South Seas in ships and box cars, but the end of the journey is the giant copra silos from which it is sent to the various oil mills

All photographs courtesy Procter and Gamble Company

America's 'Cleanest' Industry

Fats and Oils Gathered From the Antipodes Are Converted Daily Into Hundreds of Carloads of Soap

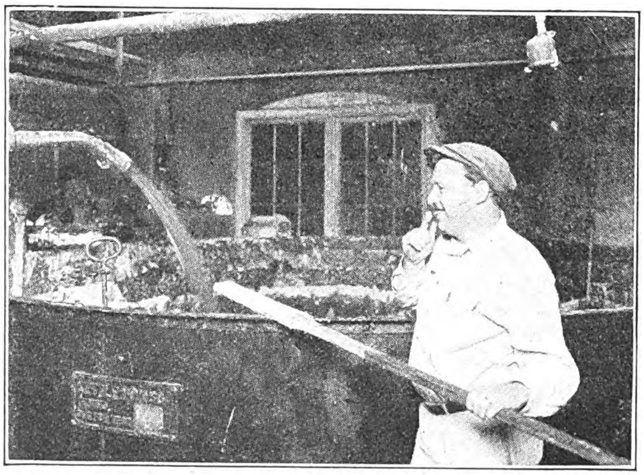
THE discovery of soap was probably connected with the boiling over of a pot into a bed of wood ashes. And a woman swore in a language we would not understand today. Or a gentler, milder, neater savage, liking clean pots, put wood ashes inside and scrubbed away with dry grass. She got a chemical reaction between the grease in the pot and the lye in the ashes which she didn't understand, but it foamed a little and cleaned the pot, so she was satisfied and called the combination by a name related to *savon* or *seife* or "soap."

Later, or simultaneously, a savage treated sores with this mixture. They healed because the mixture cleansed. Wherever it touched the hair, it turned it red. There was plenty of free alkali in those days! The Gauls particularly liked this shade of hair and introduced it as a fashion in Rome.

Contrary to all popular impressions, the Romans did not use soap. The Roman baths were luxurious, perhaps even licentious clubs, where the rites of bathing were elaborate but not cleansing in our sense. Roman youths and senators were rubbed with oil, scraped with a bone scraper, rubbed with fine sand, perfumed, and anointed. Cleopatra came clean by "erasure." Her handmaidens manipulated her with materials that were either lubricating or abrasive. The almost instantaneous, gentle, chemical action of soap and water on the skin that takes place in our modern bathrooms would have seemed to Cleopatra miraculous as well as blissful.

There is a curious connection between light and cleanliness. Early lamps were a bowl of oil in which a wick floated. The first real soap was made from olive oil. There is as great a difference between the first soap made and the beautiful white cake floating in your bath tub today, as there is between a dingy, flickering, odorous olive-oil lamp and Edison's incandescent electric lamp.

AFTER the smoking, greasy olive oil lamp came candles, neat, tall, steady, clean, beautiful. Candles in candelabra of beautiful design were multiplied until a room could be brilliantly as well as comfortably lighted. The first candles were made of tallow, hand-dipped and hand-molded, a step in civilization comparable with soap. Their original materials were the same.



TESTING THE BATCH

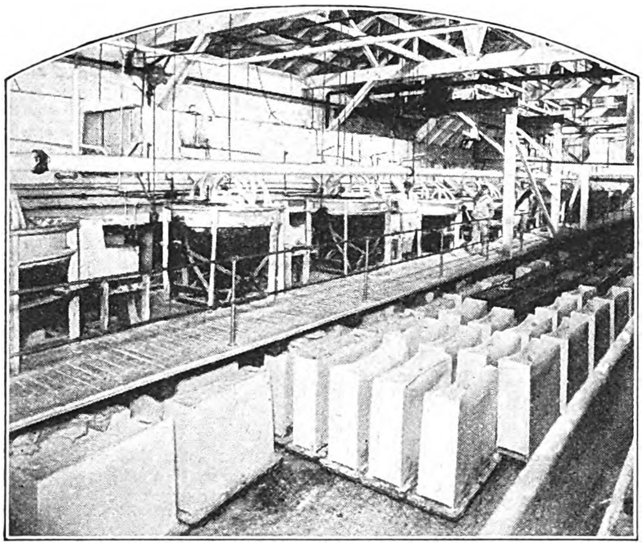
The old-time soap maker used the rule of thumb but now every step in the process is chemically controlled

About the 9th Century Marseilles became the world's soap center. At that time all soap was made from olive oil. In the 13th Century two French scientists, if we may call them so, discovered how to make caustic soda from common salt. From that time on great strides were made in soap-making. The formulas were improved, the cost decreased, and the use of soap increased.

Not so many years ago our grandmothers considered the kettle of soap prepared from fats and wood ashes sufficient for all household requirements. Now we find it necessary to use at least a half dozen different brands in every household. There must be a soap so pure and fine that it can be used with safety upon the baby's delicate, sensitive skin. There must be a soap or soap flakes so harmless that gossamer-like fabrics, filmy chiffon stockings, and dainty colored scarfs can be washed without harm. There must be a soap for the laundry. There must be soaps for washing floors and woodwork, for dishes, for scouring pots and pans, for cleaning washbowls and bathtubs.

The history of soap making is full of romance even though it is almost exclusively carried on by large manufacturers and the products are sold under brand names. Romance does not altogether die when the plant begins to expand and when the basic supplies come from half around the world in the companies' own bottoms. The story that follows is a fascinating one.

The pioneer soap-makers of America came together as partners, the one a soap-maker, the other a candle-maker. James Gamble, making candles in Cincinnati, and William Procter, making soap, found each other seeking raw materials in the same market. They combined business and lighted and cleansed the early pioneers of the Middle West. Their vision in both fields spread. Their factories now are scattered all over the country and they go to all parts of the world for materials. The empire of industry is far-flung. Its beginnings were as small as that of an obscure Corsican.



CRUTCHING

The crutchers, with villainous-looking rotating blades, give the soapy paste a uniform texture; it then runs into frames

MR. JAMES N. GAMBLE, son of James Gamble, one of the founders, has given us an account of the origin of Ivory soap. It was the concern's first intention to make a soap of pure vegetable oils resembling Castile soap. The firm bought the rights to such a soap from a group of men who were doing very little business and desired to sell the formula. They proceeded according to the formula and obtained a white soap.

The soap had no distinctive name at first and was merely called "White Soap." The members of the firm recognized the fact that it should have a distinctive name and that the name "White Soap" would not be satisfactory as it was not necessarily exclusive. They had several meetings to discuss the matter. One Sunday when Mr. Harley Procter was attending services in the Episcopal Church, Mt. Auburn, Cincinnati, the passage occuring in the 8th verse of the 45th Psalm was read:

"All thy garments smell of myrrh and aloes and cassia out of ivory palaces whereby they make thee glad." Immediately the thought flashed through his mind: "There's the name!" He called the members of the firm together and the name "Ivory" was adopted and registered in the Patent Office.

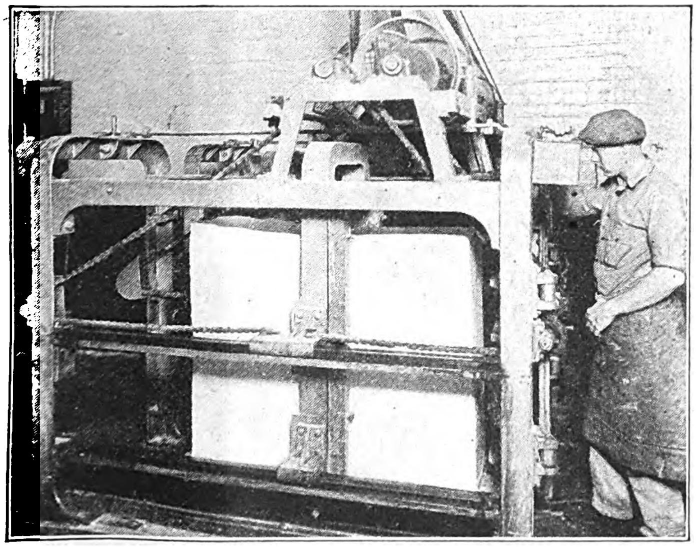
In the early days of this soap, its manufacture was a rule-of-thumb process. Troubles due to chemical causes frequently arose. These troubles were overcome, if possible, with the means at hand. The science of chemistry had not advanced far in those early days, but it was gradually coming into commercial establishments. Finally the point was reached where its application to the manufacture of soap was inevitable. In 1887 the first chemist was employed at Ivorydale and given a small space in one corner of the machine shop for a laboratory. Very soon it was necessary for him to have a helper and from that time on the chemical department has grown continuously. Today the staff of 128 chemists represents the evolution that has taken place in this one respect alone. These chemists have the obligation of maintaining the standard of purity which this soap represents.

In these paragraphs we have outlined a short history of the early use of soap and its part in the advance of civilization. It is interesting to note that the discovery and development of economical and efficient soap and soap products marked the beginning of the era in which man began his most rapid advance in industrial and intellectual accomplishments.

Not that soap was the sole impetus for our present-day civilization, but it undoubtedly was a large factor. Soap has developed cleanliness—cleanliness in the life of man—and with cleanliness comes inspiration to reach greater heights and a deeper appreciation of the joy of living.

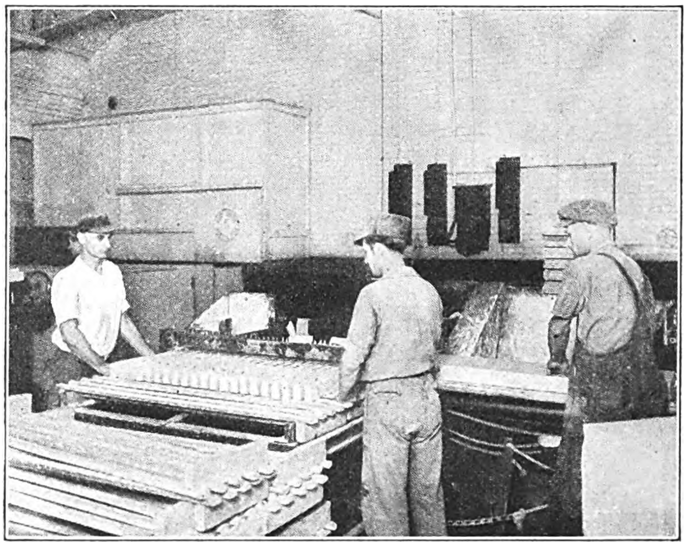
THE raw materials for making Ivory soap include cocoanut and other vegetable oils. Plantations on many islands in the South Sea belong to the proprietors who also own the bottoms in which these raw materials are transported. Cocoanuts, for instance, are chopped into "copra," dried and transported by tanker to the United States. From the port of arrival they are taken by freight to large tile silos at the main manufacturing plant. From there the copra is conveyed to the nearby mill where cocoanut oil is extracted.

The oil is then stored in large tanks



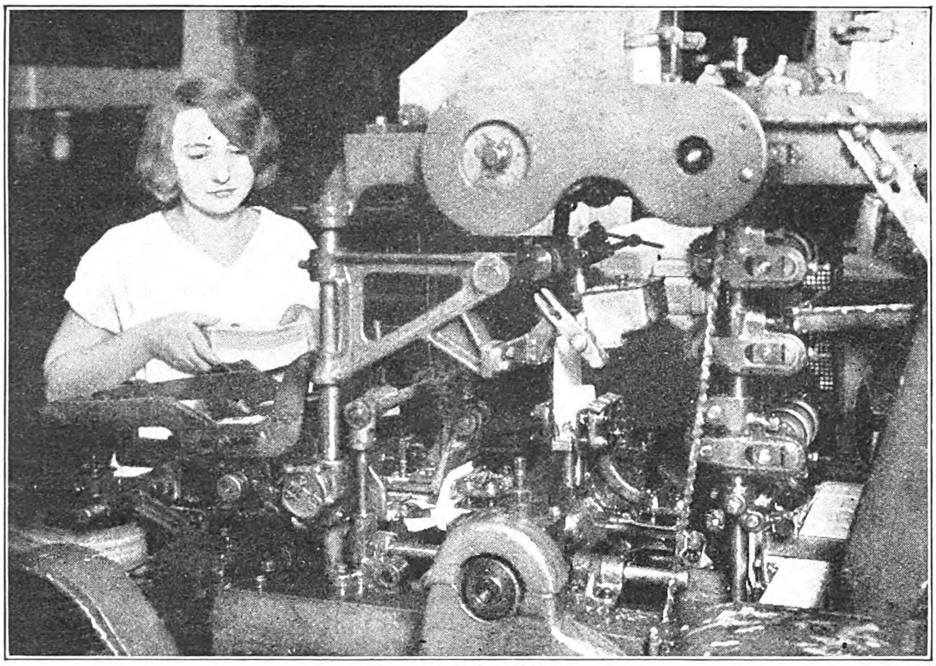
SLABBING

The thousand-pound cake is run through a machine which cuts it into slabs with the aid of horizontally-disposed piano wires



MAKING THE CAKES

The slabs are cut into long strips which are in turn cut into roughly-shaped cakes with the aid of equally spaced piano wires



WRAPPING

The wrapping machine performs its task of wrapping the cake, putting on the outer wrapper, and tucking it in with speed and accuracy that saves a vast amount of useless drudgery

until needed for the great three-story soap kettles. Here "saponification" takes place. The required quantities of oils and fats are run into the kettles through pipes and are treated with lye and water. These kettles are steam heated. Expert soap makers watch the progress of the operation, the time varying with the ingredients. Chemical analyses are made before the soap mixture is drawn off. There are pipes connected with these kettles by which the spent lye, which contains a large amount of water, and the crude glycerine are drawn off.

Chemical control of the process is necessary so that no free alkali remains to bite skin or fabric, or free oil which will prevent the soap from rinsing well. After the stock has been boiled, salt is added, which seems to gather up the globules of glycerine which are scattered through the soap paste and force them down to the bottom of the kettle. The salty glycerine and water is drawn off and then the soapy paste, still far from being finished, is removed.

TENSILE TEST

The tensile strength of all fabrics is measured both before and after washing

To secure the proper, even texture, mechanical treatment is essential. The soap, while still in a liquid state, is put through a process of mixing to reduce it to the smooth, uniform consistency needed for household use. This is known as "crutching" and is accomplished by pumping the soap into crutching machines in which revolving beaters stir it thoroughly. The soap is then emptied through the bottom of the crutcher into a metal frame or box, mounted on wheels. The soap is then allowed to cool to a solid block. Each of the large soap kettles has a capacity of from 200,000 to 300,000 pounds of soap; some 200 to 300 frames are produced from each kettle. The gigantic cake of soap weighs 1000 pounds. When cut up, this block will make 1700 cakes of soap which will fill 15 or 20 boxes. The frames of soap are allowed to cool, harden, and dry with the sides of the frames removed. When sufficiently dry the cutting begins.

THE first operation of cutting is known as "slabbing." The 1000-pound cake of soap is forced through a framework across which are strung horizontally a number of fine piano wires arranged at a distance equal to the thickness of a cake of soap. Thus the soap is cut into horizontal slabs. These are placed on another cutting machine which divides the slabs into long sticks, which are then cut into cakes on the same machine by another cross motion, wires being employed in both operations. The cakes are now properly shaped—roughly it is true—and after being dried in an air-chamber, they are stamped into the exact shape. The capacity of a stamping machine is 100,000 cakes a day. The cakes are all inspected by running them along an open trough illuminated by an electric light underneath, which renders the cakes translucent. The inspector throws out any defective cakes.

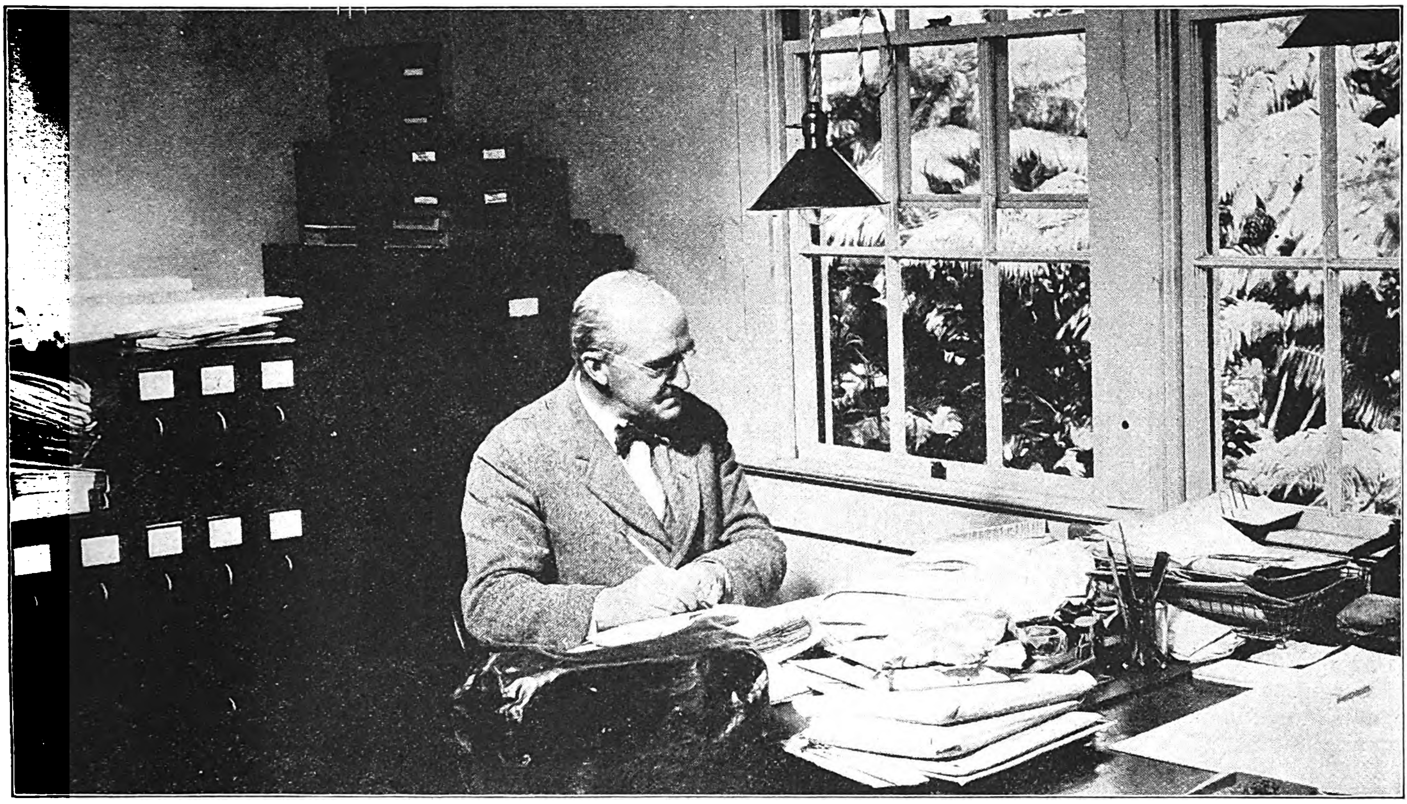
THE finished cakes are conveyed on a belt which runs between rows of girls who place them in automatic wrapping machines. The wrapped cakes are placed in boxes, which, after sealing, are run down chutes to the waiting freight cars. Facilities are provided for loading 100 cars at a time.

It might be interesting to glance for a moment at soap chips and flakes in the process of manufacture. The soap, after leaving the crutcher, is poured over a chilled drum. The thin film of molten soap cools and becomes hard and is scraped from the rolls in solid form. This process is continuous as it requires slightly less than one revolution of the chilled drum to solidify the soap. As this thin sheet of soap comes from the drums or rollers it is sliced into narrow ribbons. The belt that carries these ribbons goes through a drying room where the excess moisture is driven off, which causes the ribbon to crack into flakes or chips.

Perfumed soap is manufactured by the "milling" process. It is prepared like the flakes, then marble rollers roll the flakes into powder. In this form it can be mixed with perfumes. The powdered soap then goes through a machine which presses the soap into a long bar which is cut to size and stamped.

INSPECTING

As the cakes pass, an electric light below shows the inspector any and all defects



DR. JAGGAR IN HIS OFFICE AT THE HAWAIIAN VOLCANO OBSERVATORY

The Volcano Observatory is situated on the very rim of the great crater of Mount Kilauea and is surrounded by a lush growth of palms, maguey plants, and other tropical vegetation. Here government scientists keep constant watch of the volcano and earthquakes

Amateur Seismology

The Opening of a Campaign to Enlist the Interest of the Amateur Scientist in the Fascinating Study of Earthquakes

In a recent number of the present journal, readers who were interested in seismology were asked to write to the editor. This "feeler" brought a fair volume of response, and we now take one more step, publishing in the following pages a description of a small home-made seismograph known as the "Jaggar shock recorder." This is for recording local disturbances, not only earthquakes but also those due to truck traffic, blasting, railroads, and so on. The average amateur should be able to construct the apparatus described at a cost of about 25 dollars.

At the present time there is a lack of literature on seismology, a situation which is likely soon to be remedied. Much the same situation existed four years ago when this journal began to popularize amateur telescope making. Starting with what literature was then available the amateurs went ahead and constructed telescopes, and the demand for literature thus created was soon answered by a supply.

There are no practical instruction books for making seismographs; also there are few books on seismology itself, none of which are up to date, although a noted authority is known to be preparing one at present. Professor W. H. Hobbs' "Earthquakes" is out of print; Davison's "Manual of Seismology" is not very suitable for the beginner. The *Bulletin of the Seismological Society of America*, published quarterly, contains much earthquake information, some of which is not abstruse and recondite.

Thus, without practical instruction books and with scant literature on earthquake science the amateur will be called upon for a time to make use of his "wits." Our past experience with amateur telescope work indicates, however, that this is just what the average intelligent amateur worker likes best to do. If a thing is too easy it is not much fun.

The following matter will open the Scientific American amateur seismograph making campaign. It consists of parts of two letters, a short article from a scientific journal, and a paper describing the shock recorder, each written by Dr. T. A. Jaggar, Director of the Hawaiian Volcano Research Association, Section of Volcanology, United States Geological Survey, Volcanologist in Charge of the Hawaiian Volcano Observatory.

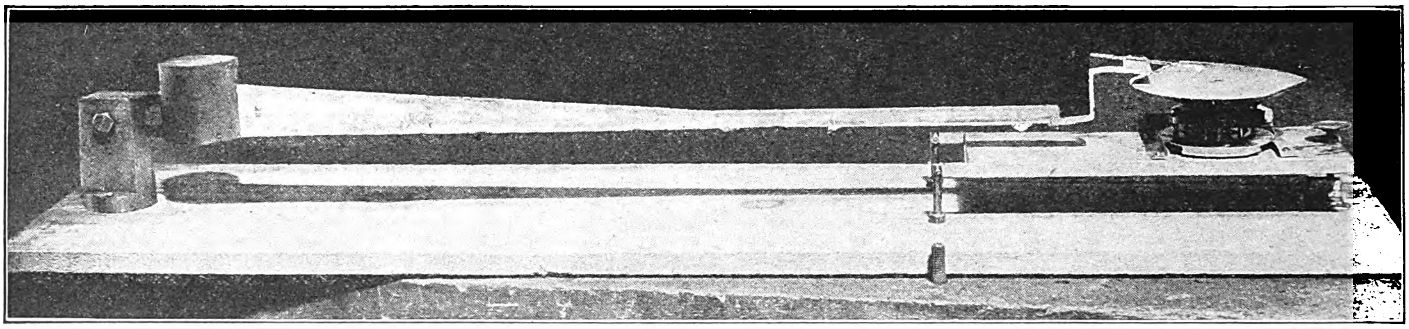
Dr. Jaggar writes: "Your letter interests me greatly, because I believe wonderful work to improve seismology could be done by amateurs. The case is like astronomy, photography, and radio, in that respect.

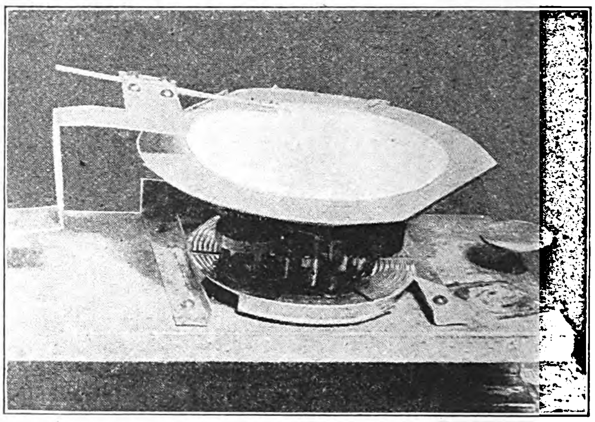
"There are five principal kinds of movement of the ground:

(1) Local earthquakes, which range from tiny tremors to felt shocks; the Carnegie Institution registers 200 to 300 little ones a year at any one station in southern California; about 900 at four stations roughly 100 miles apart.

(2) Distant earthquakes, of which there average 20 world shakers, and 57 that register half way around the world every year. This gives the distant earthquake specialist a chance of averaging one a week, with long spells, however, of not any, and short spells of several that come together.

(3) Microseismic movement, a slow-period wave movement of the ground (about five seconds), not understood, and very varia-





JAGGAR SHOCK RECORDER

This is the first model, date 1929. At the left is the weight, across the center is the boom, and at the right the stylus and recording apparatus, which is shown enlarged at the right and is described in the text

ble, thought in some cases to be due to ocean waves on cliffs far away.

(4) Quick period tremor long continued; observed at Tokyo, at volcanoes, and probably at other places. Little studied except at Kilauea.

(5) Tilting movements of the ground. These movements should have special instruments. They are being studied in some laboratories. They are very interesting adjacent to river floods, big tides, landslides, volcanoes, and earthquake faults.

“THERE is a splendid book in German, ‘Erdbebenkunde,’ by A. Sieberg, published in Jena, by Gustav Fischer (1923). There is nothing in English that is up-to-date.

“With reference to popularizing seismology, there are all the different kinds of natural and artificial motions, such as waterfall jarring, wave action on shorelines, factory tremor, city tremor, river flood effects, continuous landslip in mountains, traffic jarring, blasting, railroads, and other things now unsuspected, in which amateurs might get interested in unique places. If the amateurs were physicists, they would do as much for seismology as they have done for astronomy and photography. But they must interest themselves in all kinds of tremors. If they go in merely for earthquakes, many of them in certain localities will have long waits.

“Big gun concussions could be recorded as ‘airquakes’ distinct in time of arrival from ‘earthquakes.’ The elasticity of different regions is very different. Machines every third floor of a skyscraper would get a series of elevator machinery effects, wind effects, or traffic effects. This bears on architecture and strength of construction. Anyone living near a volcano, a geyser or a mine, would get many interesting records. People in limestone districts would get earthquakes from cavern break-downs.

“You will see that all of this would lead to correspondence between amateurs working on different tremor problems, and the invention of all sorts of electrical registrations, some of which would improve the art.”

In another communication, with regard to a shock recorder which the amateur may construct (see illustrations), Dr. Jaggar comments as follows:

“Please make it clear that this notice is preliminary. Our first model is recording shocks here beautifully and is keeping time. It stays on the job for big and little, felt and unfelt, local shocks, when the strongly felt ones dismantle our high-magnification instruments.

“The amateur's demand in feebly seismic districts is better suited to our larger machine of which I sent you the earlier blueprints. That is a machine for distant earthquakes. [To be published later if there are enough requests. Dr. Jaggar states that this machine could be built for 50 dollars.—*Ed.*]

“THE shock recorder applies to eastern Canada, the New Madrid district of Tennessee-Missouri, South Carolina, Montana, New Mexico-Arizona, Nevada, California, Hawaii, Mexico, and most of Alaska. In many places the earthquakes will not be exciting at all. In New England or Illinois the pendulum ought to be connected with a 400-day clock and run electrically, the earthquakes are so few.

“By changing the pendulum in the shock-recorder to a slow period it could be made a teleseism-recorder: the stylus tip should be made very light. It would still record local shocks. This particular work would require some knowledge of physics on the part of the operator but the simple shock-recorder without the described change is comparatively easy to use.”

The following is quoted from No. 226 of the *Volcano Letter*, a small, interesting weekly periodical published at the address stated above, and was written by Dr. Jaggar, who is its editor:

The effort to record time, duration, and size of an earthquake has heretofore appeared to require a masonry cellar at constant temperature, timekeeping like that of an astronomer, clockwork of the finest, observers directed by physicists, and five or six seismographs of different sensitiveness to be ready for big earthquakes, medium earthquakes, and little earthquakes. The Tokyo laboratory has 15 or 20 working instruments.

The present object is to secure cheapness and attractiveness, in order to get records of local motion from many places and to interest many people. This is what, for meteorology, makes the thermometer and the rain gage so useful.

THERE is an enormous moral and ethical inertia, and even resistance, to be overcome, in order to make the discovery of the distribution of small local earth motions interesting to the man on the street. Recently the presidential addresses of the Seismological Society of America, the work of several associates of the Hawaiian Volcano Observatory, an appeal from the president of a leading insurance company, and a letter from the SCIENTIFIC AMERICAN, have set the writer to experimenting, and the Jaggar shock recorder is the result.

The instrument that I have been using in the Kilauea station is made of a lead cylinder, hinged with two hack-saw blades, and writing on the face of an alarm clock. It produces an eight-inch paper disk with a line written around it like a gramophone record.

The operation is no trouble at all. The paper is smoked, runs a week, and is then dipped in dilute shellac. Any quiet corner away from machinery receives the box, about three feet long, which is screwed down. It is sensitive so as to show our feeblest instrumental Kilauea earthquakes. The time is recorded by a dial printed on the paper. The cost is about 25 dollars.

The following paper, describing the shock recorder in detail, was written by Dr. Jaggar, for presentation before the Seismological Society of America:

THE shock recorder is designed for the following purposes:

(1) To record local earthquakes in any house where reasonable rigidity and quiet can be found.

(2) To interest the general public in a cheap seismograph.

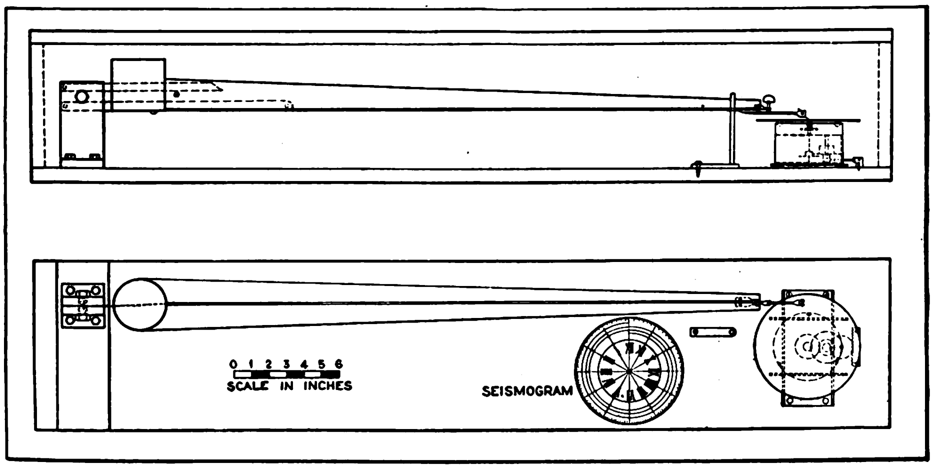
(3) To furnish data of approximate time, duration, intensity, and location, without any technical skill being required, and with very little trouble in operation.

(4) To lead to the creation of enough of these instruments to furnish co-ordinate data, more or less reliable, geographically widespread, and related to a quantitative intensity scale.

(5) To produce an instrument made of common materials, that anyone may copy, and of standard dimensions and weight.

(6) To embody instrumental constants that are simple and relatively unchangeable, so that the records will vary with the phenomena recorded, and not with the instrument, its placing, or its management.

(7) To register earthquakes as small as R. F. 2 and as large as R. F. 9. [R. F. refers to the Rossi-Forel scale of intensity.—*Ed.*]



SCALE DRAWING OF THE SHOCK RECORDER

The cost should be about 25 dollars, depending on the resources, both in material and skill, of the maker. In the average case one should be able to pick up most of the materials around the house or shop, and the rest are inexpensive. Little machine work is required

There are many occasions when negative information is valuable in seismology. That a well known earthquake was *not* recorded at such and such a place is useful knowledge. That it was not felt, or that everyone slept through it, furnishes no positive information. That an instrument of R. F. 2 grade showed not a trace at the definite hour specified is a scientific measurement. Fifty such instruments giving records and non-records across 500 miles will pretty well delimit the shock.

The shock-recorder is a single horizontal pendulum made of a post of angle irons, two hacksaw blades for hinge, a cylinder of lead weighing nine pounds, a long stiff light arm of thin aluminum carrying a very small free stylus, an ordinary eight-day clock which serves for both timepiece and drive, a rotating horizontal disk on the hour-hand spindle, a smoked registration card which is printed in the center as a reversed clock dial, a box, and a few bolts and screws.

The movement both drives the mechanism and keeps time for a week. The whole clock, with smoked disk facing upward, moves laterally two millimeters [a millimeter, mm., is about $\frac{1}{25}$ of an inch.—*Ed.*] on a straight track every 12 hours automatically. This has the effect of making the pen scribe a new circle offset two millimeters from the last one every half day. The card is changed and varnished at the end of a week.

The smoking is done with tongs having metal disk jaws just the size of the dial. The dial card is thus grasped by the tongs with the dial untouched by the smoking. The outer smoked band is 40 mm. wide.

The accompanying drawing shows the rugged pendulum, which weighs four kilograms, (8.8 pounds) and is adjusted to a one-half-second period. It is undamped and designed to synchronize with ordinary local earthquakes. It is not troubled by teleseisms or microseisms. The static magnification is 19.

The two horizontal hacksaw blades stand one above the other in the same vertical plane, and are pinched between angle irons bolted to the baseboard. They are 16 mm. apart, and the lead cylinder is cast about them, its longer axis upright, its bottom flush with the lower edge of the lower blade. The cylinder, 78 by 76 mm., hangs with its center 50 mm. from the upright line of support.

The lead weight is supported on the upper blade five mm. above its center of mass, and the suspension is largely in compression, with only the upper part of the upper blade in tension, at the line of support. This tends to instability, a desirable feature.

THE boom is made of thin aluminum bent in the form of a paper arrow, 980 mm. long to the stylus tip from the center of mass. The boom encloses the outer ends of the hacksaw blades. The pendulum and clock are contained in a rectangular box 126 by 26 by 28 centimeters in length, width, and height, with a glass window at the right over the dial. The baseboard is screwed down in a closet, cellar, or other quiet place.

The operator sets up the instrument with the heavy mass preferably toward the north. The clock is lifted from its ring support, turned over, and wound. It has a common nickeled case, with the rotary disk of aluminum replacing the usual dial, and actually taking the place of the usual hour hand, with one revolution in 12 hours. The clock ring is on tracks fore and aft, and the replaced clock is slid forward until a protruding pinion engages a rack on the baseboard at the right. This is what moves the registration disk to write spiral records. The card dial is now smoked and laid on the disk over the clock. Meanwhile the pendulum boom has been locked by a wooden button away from the clock. This bolt is released and the stylus comes over the smoked cardboard. Before the stylus is dropped on the smoke surface, the card dial is rotated until the actual time corresponds to that part of the dial opposite the stylus position. Then the stylus tip is overturned on to the smoke. The machine is now a timepiece and a shock-recorder for a week.

It may be examined every day through its window. At the end of the week the card is removed and shellacked. Every successive revolution corresponds to the 12-hour period indicated by the dial. All are on a disk or glossy cardboard six inches in diameter. Earthquakes from grades 1 to 9 Rossi-Forel will appear as white cross lines, in length from a fraction of a millimeter upward. The time line is about 35 mm. to the hour, permitting some evaluation of earthquake duration with a magnifier.

This machine in the hands of insurance companies, school teachers, and interested amateurs should be a beginning of quantitative data from popular observation.

The Speed Record of the Universe*

Light Holds the Universal Speed Record. There Is Good Evidence That a Higher Velocity Is Impossible

By PAUL R. HEYL, Ph.D.
Physicist, National Bureau of Standards

“I HOPE I do not take up too much of your time,” said the visitor as he entered the scientist’s office.

“You do not come often enough for that,” replied the scientist, smiling. “What can I do for you to-day?”

“Talk to me,” said the visitor, seating himself.

“About what?”

“Well, I have been reading lately about Professor Michelson’s measurement of the velocity of light, and I have been thinking quite a little about it. It is certainly wonderful that a man could do this at all. Think of it! Something goes whizzing by fast enough to go seven times round the earth in a single second—and a *man* times it as it passes!”

“Of course,” said the scientist, “we must remember that he timed it over a distance of several miles.”

“Several miles! If I had been attempting the job I should have felt that I would need several thousand.”

“AS a matter of fact,” said the scientist, “the first successful measure of the velocity of light was made over several million miles. Roemer, in the 17th Century, determined this constant of Nature by timing the eclipses of the satellites of Jupiter. In this connection there is an interesting piece of history. The velocity of light is distinctly a physical constant, and the astronomers rather felt that they had the laugh on the physicists for having to borrow astronomical facilities to make a physical measurement. But in the 19th Century physicists found that they could measure the speed of light over a few miles of the earth’s surface more accurately than it could be done over astronomical distances. As a consequence, astronomers had to correct their estimate of the earth’s distance from the sun by means of the physicists’ determination of the velocity of light.”

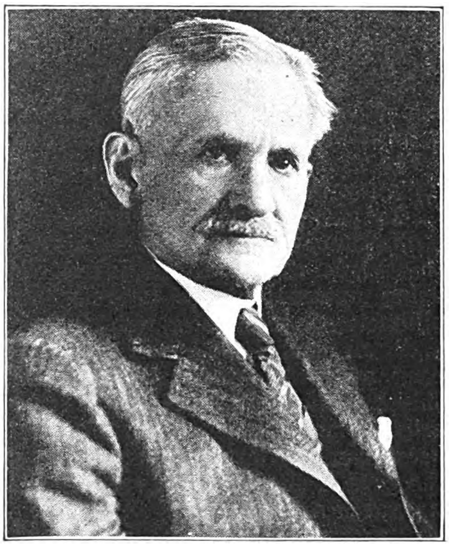
The visitor laughed.

“Is there anything else that moves as fast as light?”

The scientist shook his head.

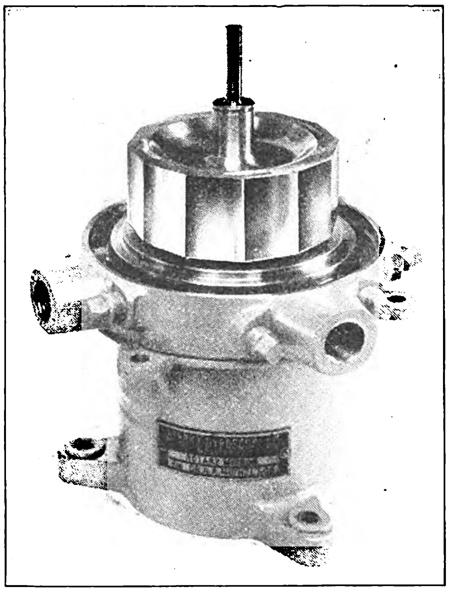
“Nothing that we can measure. Light travels about a million times as fast as sound in air and ten thousand times as fast as the earth in its orbit.”

“How about gravitation?”



MICHELSON AND APPARATUS

The famous American optical physicist, photographed at the “Michelson Meeting” of the Optical Society of America which was a tribute to him. Below, the 12-sided mirror with which he measured the velocity of light at Mount Wilson



Courtesy Sperry Gyroscope Company, maker

“We have never been able to devise a method for measuring the speed of gravitation, because we can not tell which way it goes. To all appearances it goes both ways at once. The earth attracts the sun just as strongly as the sun attracts the earth. And now Einstein tells us that there is no gravitational force between the earth and the sun. If this be true, there is no speed to measure.”

“That is a little bit too deep for me,” said the visitor, laughing. “Let us get back to something tangible. How about the heavenly bodies? Do not some of them move much faster than the earth?”

“Quite so, especially the nebulas; but the most rapidly moving nebula yet discovered moves at about one eightieth of the speed of light—some 2400 miles a second.”

“That is not even a good second,” said the visitor, disappointedly.

“We must remember,” said the scientist, “that in comparing the speed of light with that of a heavenly body we are speaking of two very different things. Stars and nebulas are matter, possibly rather tenuous and gaseous, but still matter. Light, on the other hand, is energy. It may be much easier for a train of waves to run rapidly than for a material particle.”

“BUT are not matter and energy regarded as pretty much the same thing nowadays?”

“They are regarded as different states or conditions of the same thing, just as are ice, water, and steam, or diamond and graphite. So with matter and energy; in essence they are the same, mutually convertible into each other; in their properties and behavior they are quite different. Material particles can be made to move with different speeds according to the force applied to them, but the velocity of light in empty space is always the same.”

“A brighter source of light does not correspond to a stronger push?”

“No. The velocity of light is independent of the intensity of the source.”

“But suppose one struck a light on a moving train; would not the speed of the train be added to the speed of light in a forward direction, and subtracted backwards? That is what happens when one fires a gun from a moving car, is it not?”

“That is again a case in which matter differs from energy. The speed of light is independent of the speed of the source.”

“How fast can matter be made to move? Does this nebula you speak of hold the speed record?”

“For heavenly bodies, yes; but we can do better than that in the laboratory.”

“Rather a difficult experiment, isn’t it?”

“No, not at all, nowadays. Every user of a radio set repeats this experiment, although he may not know it."

---

*Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

"Do you mean to say," asked the visitor, "that in my radio set there is something moving faster than 2400 miles a second?"

"Yes, the stream of electrons in the tube."

"Well," said the visitor, "I guess this is another case of familiarity hiding the wonderful. I knew—or thought I knew—all about the action of radio tubes. I knew that electrons are supposed to be tiny particles, each with a negative charge of electricity; that the filament in the tube shoots off these particles when it is heated; that the electrons are guided in their flight by the law that like electric charges repel and unlike attract; that for this purpose the filament is made negative and the plate positive by the B battery."

"QUITE correct," said the scientist. "The interest of the matter is in its quantitative aspect. These particles are extremely small and light, and therefore easily accelerated. Under the persuasion of the joint attraction and repulsion produced by the voltage of the B battery the particles move at a very high speed."

"I see," said the visitor. "I was thinking that anything material moving with such a high velocity would be a dangerous projectile. What saves the situation is that the particles are so small."

"Exactly," said the scientist, "but they are still sufficiently dangerous when at large, as any one can testify who has been burned by radium."

"How fast can such particles be made to move? What is the laboratory speed record? Can we match the speed of light?"

The scientist shook his head.

"No, not quite. Tubes have been made, adapted to stand a high voltage, in which electron speeds have been observed which are over nine tenths of the speed of light."

"Observed or calculated?"

"Well," said the scientist, smiling, "of course such tubes can not be built a mile long. They are usually measured in inches, and it is out of the question to time directly the passage of an electron over any such distance. But by applying a cross fire of magnetic or electric attraction to the charged particles in flight they can be deflected slightly, and from the amount of this deflection their speed can be calculated."

"Nine tenths of the speed of light!" said the visitor. "That may be called forging to the front of the race. How soon will you be up with the leader?"

"Never."

"What! And you are a scientist?"

"The difficulties are serious."

"Oh, come now!" said the visitor. "Do I have to encourage you? Think of what science has accomplished in the past. Suppose it were necessary to build a vacuum tube rugged enough to stand a few million volts? There must be a dozen men in this country who have the means and the sporting blood to finance an attempt to capture Nature's speed record!"

THE scientist smiled slightly and shook his head.

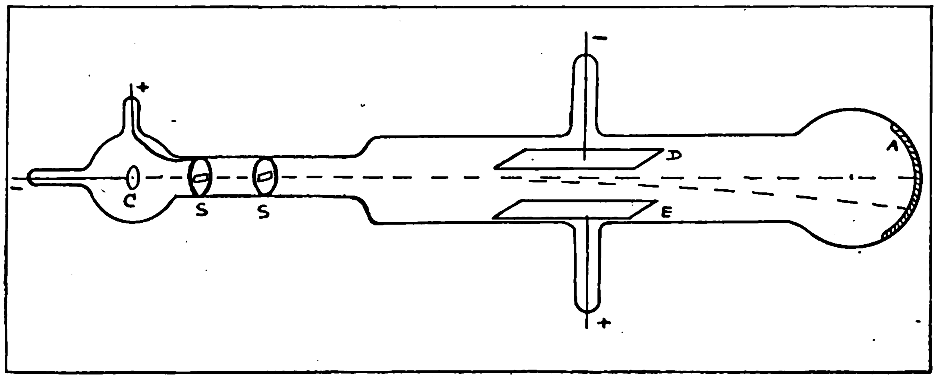
"That is something which money can not buy. Nature guards her speed record jealously against profane approach. As the velocity of an electron approaches that of light the expenditure of effort on our part increases by leaps and bounds. We have good reason from theory to believe that to give a charged electron the speed of light would require an infinite force."

The visitor looked thoughtful for a few moments. Finally he said: "There is something fascinating about what you have just told me. Here is a child playing with his mother. As long as what he does is harmless his mother tolerates even a considerable discomfort on her part but if the child attempts something that can not be permitted he is conscious at once of what seems to him to be an infinitely superior resistance."

The scientist nodded approvingly.

"You have the correct scientific spirit."

The visitor flushed, and went on:



MEASURING THE SPEED OF FLYING ELECTRONS

Electrons are emitted from cathode *C*, pass in a narrow bundle through slits *S,S* and strike a fluorescent screen *A*. If the plates *D, E* are oppositely charged, the electrons are deflected

"But what is there in the tube to resist the motion of the electrons? Is it not exhausted to a high vacuum?"

"The best obtainable; a very good approximation to empty space."

"Well then—in an empty tube, with a good electrical push and pull acting on them—what is there to retard the particles?"

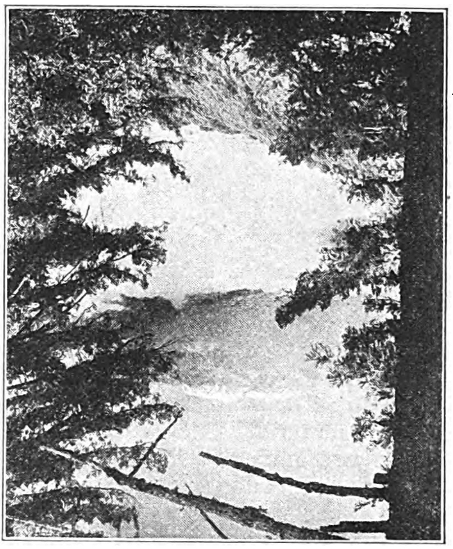


Photo by Ferdinand Ellerman, Mount Wilson Observatory.

MOUNT SAN ANTONIO

Light from one face of Michelson's rotary mirror, turning at 33,000 R.P.M., flew to a mirror 23 miles distant, returned, and was caught on the next surface

The scientist smiled broadly.

"In an 'empty' tube, how can there be any push or pull on a particle?"

The visitor laughed.

"I see the point. I guess you have me there. But I do not believe you can answer that question yourself. Perhaps, after all the pumping, the tube is not empty."

"THAT," said the scientist, "is an objection which we can not argue away. Space, it appears, may seem empty and yet be capable of reacting in a manner which we can not imagine as coming out of nothing at all. The older physicists said the answer was 'ether.' That word is rather out of fashion today, but the fundamental idea back of it still persists. For instance, Einstein has renamed it 'curved space.' "

"It certainly seems as though there must be something there," said the visitor, thoughtfully. "Light always has the same speed, independent of the intensity or motion of the source. When we try to move electrons with the speed of light, empty space itself rises up to stop us. And how we can accelerate them in empty space, I can not see."

"Nor I either," said the scientist. "The speed of light doubtless has some meaning. It must be intimately connected with the ultimate nature of things; but just how we can not yet say."

Weighing With Light

A Novel Instrument Which Weighs a Moving Sheet of Paper and Writes a Record of Its Observations

By FREDERICK A. PEARSON*

THE most imponderable thing in our daily experience, a ray of light, is now being used as a balance scale to determine the weight of paper in process of fabrication. Applied to the largest paper machine in the country making high-grade ledger, this instrument is telling the machine operator a story about his product, which he could not previously have divined.

The Opacimeter, so called because its readings depend upon the opacity of the material measured, demonstrates a recently developed use of the photo-electric cell in scientific measurement. The minute effect of light passing through the moving web of paper is magnified by vacuum tubes, and the resultant message passed on to a moving pen for permanent record.

In taking over the function that was once thought to be limited to that wonderful instrument, the eye, the Opacimeter can accomplish results far beyond those of its human prototype. Not only is its story unbiased by imagination, but it is tireless, while the human eye loses its sensitivity after a few seconds of intense concentration.

PAPER has always been difficult to weigh. The mill method of weighing is to cut a dry sheet 17 inches by 22 inches and weigh this upon a specially graduated gravity scale, which reads the weight in terms of a ream of 500 sheets of this size. Paper such as the SCIENTIFIC AMERICAN is printed on weighs approximately 18 pounds for a ream of this standard size. This paper in the trade would be called 18-pound paper, taking for granted the size and number of the sheets required to make this weight.

Now, were you handed two sheets, one of 18-pound paper and another which showed a weight of 18½ pounds, it is barely possible that by holding them together before a strong light, you could tell which is the heavier. However, if you were to look through one sample and then another and then a third, no human eye could measure accurately the difference in their weights. The mind can not retain a memory of a value in terms of light long enough to compare it with a succeeding value.

Such a recording of successive quantities of light is possible for the Opacimeter, and with a sensitivity far greater than that of the human eye. A variation of ⅛th of a pound in 18-pound paper is marked by a movement of the pen ⅛th of an inch sideways, and double or treble this sensitivity is possible if desired.

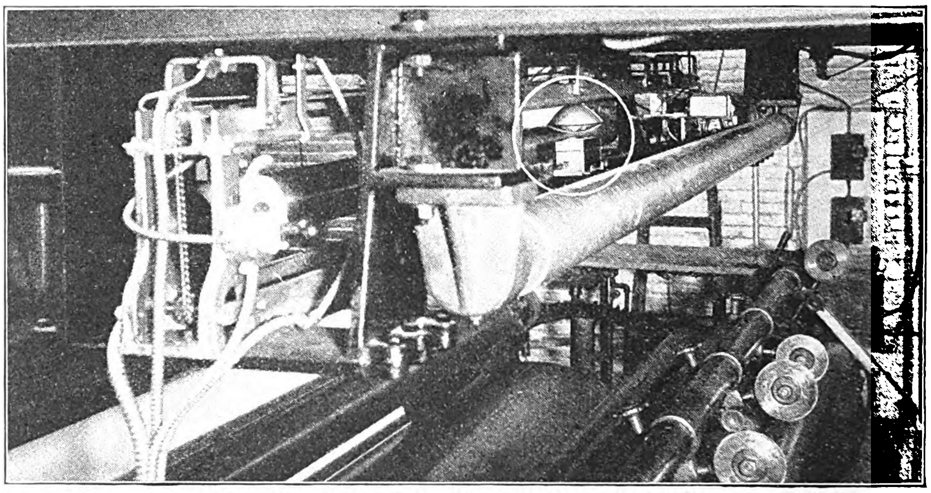
There are some striking similarities between the Opacimeter and the human organism. The eye would be of no value, were you deprived of the muscles to move it about; the electric eye must be equipped with a motor organism. In the human eye the message of light falling on the nerve ends is carried by the optic nerve to the brain, where it is translated into a consciousness of the object seen. In the Opacimeter the "optic nerve" is a rubber covered cable, and the "brain" a combination of resistances and amplifying tubes.

In the human system the translated message would travel by the nerve of the arm operating the muscles of the hand and fingers. In the Opacimeter the message is carried to a coil of fine wire hung in a magnetic field, and mechanical jaws energized by an electric motor grip the pen and direct it back and forth across the recorder paper. This is an electrical Robot, which not only sees, but writes down what it sees.

Yet while the Opacimeter has certain advantages in scientific measurement, a closer study of the analogy only serves to emphasize the illimitable gulf between the miracle of conscious organism and the man-made mechanism which in a blundering way attempts to imitate it.

The basic theory from which the Opacimeter has grown is simple. Given a photo-electric cell and a source of light, then by placing a material between them, some form of measurement of the material should be possible. Add to this the ability of vacuum tubes to amplify minute electrical impulses, and it would appear reasonable that such a means of measurement could be made capable of automatically recording the message.

From these simple relationships the Opacimeter was evolved. At the start no attention was paid to the motor function of the device, but every effort was directed toward the use of the eye, and the development of the electrical brain. The mechanical hand was already available in any one of the recording potentiometers used in pyrometric service, and the Leeds and Northrup instrument was chosen for this device.



TRACK ASSEMBLY OF THE OPACIMETER

The paper in process (not shown here) moves across the rolls between the spotlight and the photo-electric cell, both shown in the circle. Gear shifting mechanism at rear end of tracks

The currents available from photo-cells of size suitable for this work are in the nature of millionths of an ampere, or micro-amperes, when the full light of the lamp is directed upon the cell. Although minute in comparison with the usual currents flowing in an every-day lamp, which uses about one fourth of an ampere, micro-amps are strong enough to move the delicately hung mirrors of sensitive galvanometers, indicating the effect of light.

When, however, the light was shaded by a sheet of paper, the currents available from the cell were far too weak to give the necessary effect, and since it was required to note the almost imperceptible gradations of paper, a simple hook-up between the cell and the recording mechanism was out of the question.

---

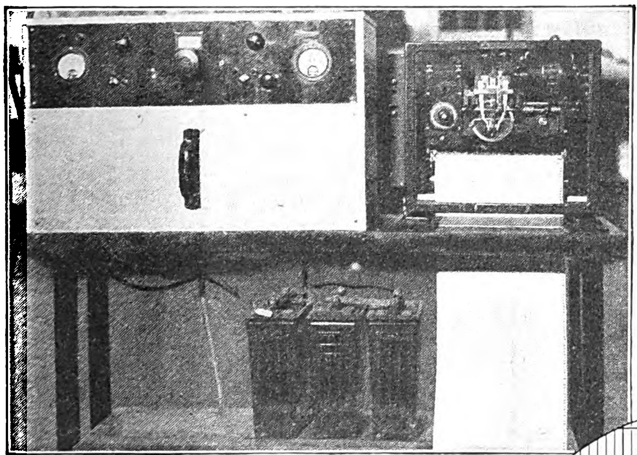
* See "Among Our Contributors," page 373.

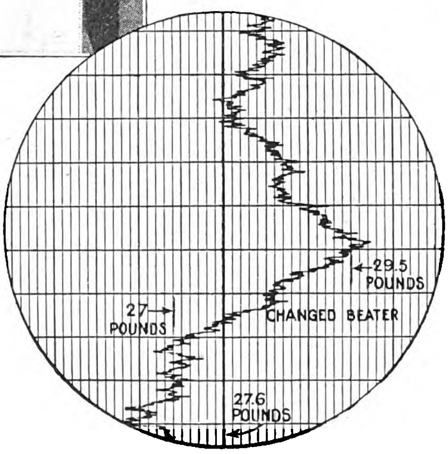
Accordingly a vacuum tube amplifier was designed using one of the simplest known amplifying circuits. This was of sufficient sensitivity to give results for minute gradations of light, but it immediately introduced into the measurement a series of errors which threatened to eliminate any advantage possessed by the otherwise accurate device.

HERE was a foot rule, which at any instant might become elongated to 100 feet. Measuring an inch on this scale was a haphazard and extremely speculative business. It was found that the errors could arise from many causes. A change in filament voltage brought in one series, and a change in plate voltage another. Resistances which in radio circuits showed all the conservative characteristics of responsible resistances, when used for minute measurement, became as erratic as prima donnas.

Filament emission varied from hour to hour without reasonable excuse, and rectifying devices that were giving complete satisfaction to thousands of radio listeners showed up as spotty as a leopard. In the confusion of shifting electrical values, only the cell carried on in a business-like, non-argumentative way.

A system of insulation which was in keeping with the best radio receiver engineering proved to be utterly inadequate for the Opacimeter. Although the potentials on the signal circuits were small, it soon became apparent that leakages were taking place. Not until the elements were arranged and insulated as if they were at a potential of 25,000 volts, was the record a true reproduction of light effect.

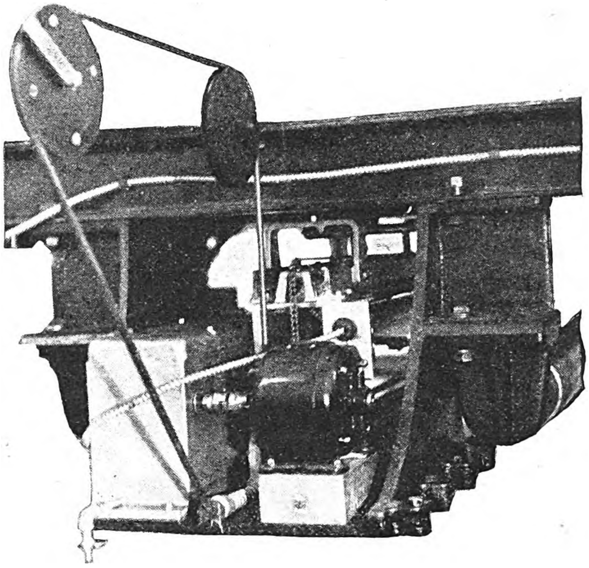




CONTROL CABINET AND ITS RECORD

Control of all apparatus is obtained by switches on panel; recording potentiometer at right above writes the record on paper. At the right is shown section of an actual record, 27.6 pounds per ream—desired weight—being shown by heavy line, and slight variations in weight by the wavy line. Since the operator could instantly check the weight of paper, he was able to adjust it to normal, as shown by graph, after it had suddenly increased due to change of the beater used

Means were then worked out to establish voltages that would be constant. In the Opacimeter the filament voltage is held to within 1 percent of one volt, and the plate voltages are held to close limits. The resistance problem was overcome by tearing down commercial resistances and rebuilding them for special functions. Resistances of values of 100,000 ohms or less of satisfactory accuracy were obtainable from the laboratory instrument makers.



REAR END OF TRACK ASSEMBLY

A small motor drives through gearing the carriages on their tracks; the light receives current from a trolley

It then became possible to consider the elimination of the constitutional vagaries of the tubes themselves. This was done by selecting two tubes which on test showed similarity in all their characteristics. Then by balancing one tube against the other by means of a novel balancing circuit, the errors cancelled out and left a residue of amplification accurate enough for the purpose.

As a result, by turning one control dial, the tubes can be brought into balance so that with 90 volts impressed on their plates, these plates can be readily brought to a potential differing from each other by not more than 1/100 of a volt. At the same time the adjustment changes no resistance value in the amplifying circuit, and consequently does not alter the slope of the "mu" line within the limits of measurement used.

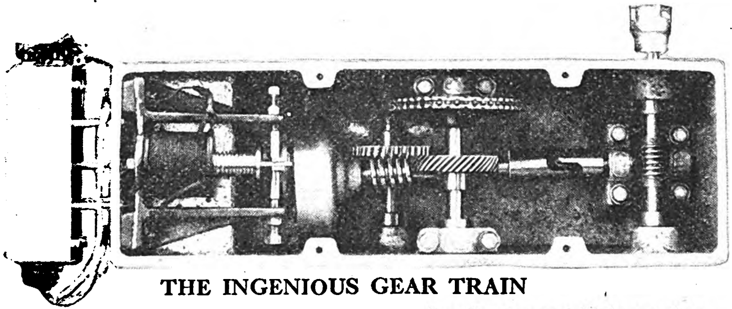
The Leeds and Northrup potentiometer chosen to read the message of the light effect, which message was now highly magnified on the plates of the tubes, is a remarkable instrument which automatically adjusts itself to a point of no signal current. This instrument has the immense advantage that at such point there are no further errors or heat variations introduced into the circuit by the recording apparatus.

In this way the light impulse was brought from the electrical eye to the brain and to the finger with its pen. It now became apposite to consider the light which was to shine through the paper and start the train of effects into operation. The one outstanding characteristic demanded of this light was "constancy," inasmuch as a variation of the applied light would inevitably be recorded as a variation in the paper measured. The pursuit of this rare trait of character consumed a year, but was finally surmounted by the fabrication of a specially designed motor-generator set through the courtesy of the Ohio Electric and Controller Company; this set, in combination with storage batteries and a simple adjusting circuit, maintains the light voltage of six volts within limits of 1/50 of a volt.

IN March, 1929, an instrument was completed and tried out on moving paper in a paper mill. It was immediately apparent that this was a practicable method of measuring the weight of paper. But no means of taking the eye all the way across the sheet in fabrication had yet been developed, and therefore the Opacimeter could effect only about one eighth of its ideal usefulness. To understand the conditions better, a word of description of a paper machine may be helpful.

Paper comes to the paper machine as a milky liquid consisting of a great deal of water and a small amount of stock. The stock consists of the shredded and beaten fibers of rags or wood pulp, chemically prepared, to be made into paper. This liquid pours on to a moving screen of fine mesh which not only advances with its liquid load but vibrates laterally to form the texture desired in the paper. As the screen moves forward, the water falls through the screen, and at the end of the machine proper, the sheet of united fibers, in appearance like wet blotting paper, rolls into rotating presses. This continuous sheet passes over steam heated rolls and finally emerges as paper.

To weigh this sheet as it goes along, and all the way across, by the photo-electric method, it was necessary to find means to convey the photo-cell on one side of the sheet, and the light source on the other simultaneously. This was effected by constructing tracks below and above the continuous sheet, carrying the elements of the device on suitable carriages.



THE INGENIOUS GEAR TRAIN

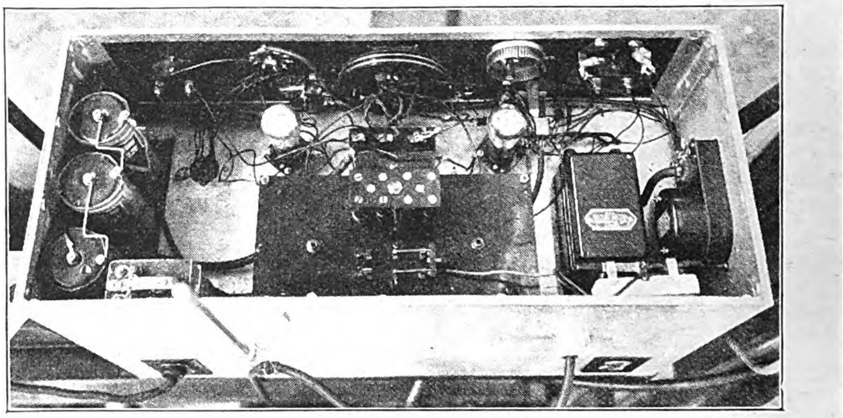
Since the carriage was to advance at slow speed and return at high speed, a difficult problem was encountered by the designers. They solved it perfectly

The matter of relative distance between the elements was controlled by careful fabrication of the trackways, and by allowing the sheet of paper to just contact a smooth crystal surface. Dry chain drive was used throughout. As the recorder was driven by a synchronous motor, the carriage drive was designed for this type of motor. Since the time limits were close, no clutching mechanism was desired, but a direct geared connection between motor and carriages was indicated.

NO electrically controlled gear shift appeared available. The ratio of advance to return speeds chosen was 1:30, and further to simplify control parts, it was required that the gear shift use the power available from its own motor drive to shift its gears.

Employing a hitherto untried system of bringing gears into mesh radially, and effecting the change of gears by a simple epicyclic train, the requirements of the gear shift were met. This construction lent itself favorably to electric control, as a relative movement of the gears could be effected by snapping a trip into a notch on a moving disk, hence a small solenoid could do the work of moving parts 100 times heavier than its plunger. In addition to the gear positions there were two neutral positions of no drive available, one of which was necessary when the carriages waited at home for the operator's signal to go across the moving sheet.

In operation the Opacimeter is practically automatic. Once started across the moving sheet, the recorder writes the story of the weight of the paper passing between the light and cell without attention. At the home position, which is at the back of the paper machine, is a standard to receive a small sample of the paper the operator wishes to make. Since there is no relationship in physics between the intensity of a ray of light and the weight of a piece of paper, it is impossible to calibrate the Opacimeter in terms of absolute weight. However, with a correct sample to start on, the Opacimeter can then indicate by how much, if any, any further sheet of paper varies from the sample. This is after all the usual method of measuring. The Opacimeter sets off one beam of light against another, and tells an accurate story as to its degree of similarity with an accepted standard of comparison.



THE "BRAIN" OF THE OPACIMETER

Upper compartment of the control cabinet with cover removed. Back of panel are resistances, meters, and pilot lights. The cable entering the back of cabinet carries the "message" from the photo-electric cell to the recorder

Consider a paper machine that turns out three million pounds of paper per year. This paper is made to order in various weights on a basis of pounds per ream. Should the manufacturer overrun the specified weight by one half a pound throughout the year on an average of 20-pound paper, then he is making a present to the consumer of 2½ percent of his paper, or is shipping out in the given case 75,000 pounds more paper than he is paid for. Obviously this is a condition which could not very well occur in other industries, say sugar, where the error in a factory's shipments would be held to much smaller limits.

It is too early to draw conclusions as to the value of the Opacimeter for measurements other than paper. There are many fields where such a means of measurement ought to be applicable, as for instance the weaving of cloth, film and celluloid manufacture, the measurements of the densities of liquids, and kindred applications. Each adaption of this instrument can only follow exhaustive study of the particular problems of the field concerned.

NOR is its function limited to the measurement of light alone. Its sensitivity to electrical impulse is so great, that it opens a new realm in measuring instruments. A movement of the recorder pen on the recorder paper is caused by a change in the photo-cell circuit of four billionths of one ampere. This is, then, an electrical microscope, and who can predict to what use it may be put in the research of minute electrical effects, as, for example, X-ray examinations or cathode-ray analysis.

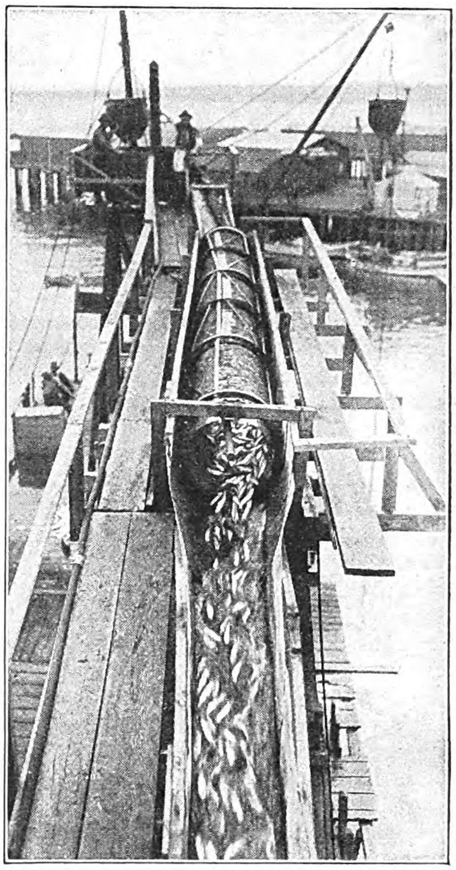
It is obvious that a development of this character could not have been brought to completion without the co-operation of many individuals and organizations. A complete list would be impossible for this article, but the author can not close without a word of appreciation, not only to those already mentioned, but also to the staff of the great research laboratory of the General Electric Company from whose brilliant research originated the thoriated filament and the photo-electric cell. The practical application of the Opacimeter to paper-making would not have been possible without the generous co-operation of the Directors of the Byron Weston Paper Co. of Dalton, Mass., who, already leaders in their industry, do not hesitate to follow up any experimental work which may tend to improve their product.

Sardine Packing—A Growing California Industry

POPULAR imagination has it that most sardines come from Spain, Norway, or other European countries. It will come as a surprise to many people, therefore, to learn that California packers turned out last year 120,000,000 cans of this choice food in one-pound oval cans and at least 20,000,000 cans of other sizes besides many by-products such as fish meal, fish oil, et cetera. The one-pound can has proved to be most convenient for a family of three or four persons.

California sardines, from six to nine inches long, are caught only on dark nights when the schools may be located by the phosphorescence their movements cause. Catches are taken to the canneries at dawn and packed at once. Sardines for the F. E. Booth Company, at Monterey, are all caught within five miles of the plant. This plant, the largest single unit plant of its kind in the world, was the first to use the one-pound oval can and has a capacity of 150,000 to 200,000 cans a day during the August to March season.

Incoming loads of sardines are weighed at the plant, are then flumed through a revolving wire drum under a spray of water to remove the scales, and are then carried to the receiving room where they are cut, cleaned, and brined. After drying to remove excess moisture, they are prepared for packing. Firm fish are selected by women and placed in cans; the cans are then inspected and placed in a precooker. Following this, the cans are drained, filled with tomato sauce or mustard, hermetically sealed, and placed in retorts where they are cooked under pressure. Upon removal from retorts, the cans are ready for packing into boxes for shipment to world markets.

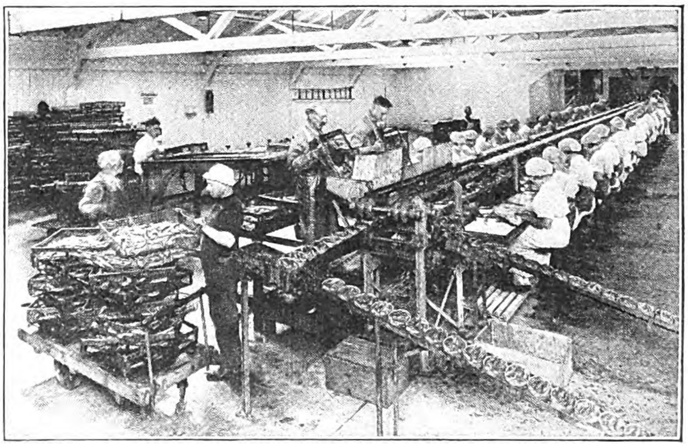


OFF WITH THE SCALES ➤

This revolving drum of heavy wire mesh, and a high pressure stream of water, serve to remove scales from sardines as they are flumed through. The operation is rapid

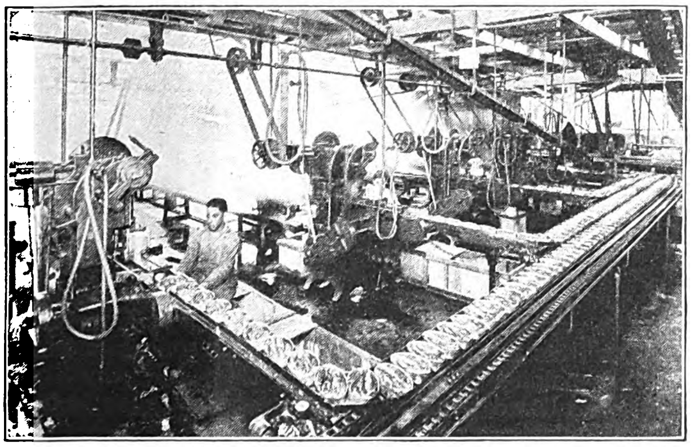
COOKED IN OIL

Tons of sardines drying after the first cooking. Some packers fry them in oil; others cook them in brine, with steam, or pack them raw



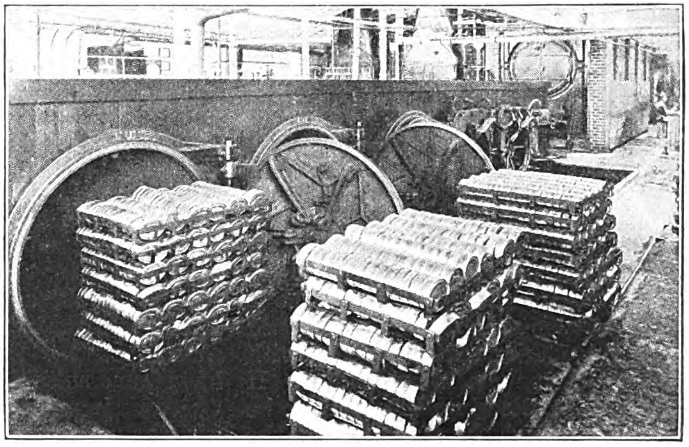
HAND PACKING

Long lines of women packers select firm, unbroken fish and pack them into oval cans which are carried away by conveyor belts



MACHINE-SEALED

Conveyor belts bring the packed but open cans to this machine which fills them with the proper kind of sauce or mustard and hermetically seals them. In this operation, no hands touch them



RETORT-COOKED

The sealed cans are placed in retorts where they are kept for an hour under high pressure at a temperature of 240 degrees for sterilization. This final step insures purity and wholesomeness

Supplying the Reptile Leather Demand

Land and Water Lizards from India, Ringed Lizards from Java, Alligators, and Others Are on the "Wanted" List

By H. J. PAYNE

BECAUSE women have decided that they like reptile leathers, they have created veritable chaos in the kingdom of crawling creatures. Their demand for shoes and handbags made of the skins of alligator, lizard, or snake has developed a new means of livelihood for natives in out-of-the-way parts of the world—Central America, India, Borneo, Siam, Java. At this time the supply of these skins for American tanners who lead the world in their conversion to leather is probably running around 500,000 snakes, 750,000 alligators and 1,000,000 lizards annually.

It's a strange business, this capturing of reptiles. Hunting and subduing them is often fraught with danger; hardships are involved that would probably make the business altogether impractical if white men, unused to the rigors of the tropics, had to be relied upon to maintain the industry.

In the case of alligators, most of the hunting is done by night. Usually 40-foot canoes, which are manned by three hunters, are used. The hunters, skilled in the art of outguessing the saurians who are possessed of more than a fair share of shrewdness, push along silently through the dark night which is broken only by a beam of light from an acetylene torch worn on the head of the bow man. Two men propel the boat, one of whom will act as harpooner when the eyes of a reptile have been flashed and the boat has come in range.

BECAUSE the 'gator's interest in the dazzling light is overpowering, he remains motionless while the boat glides up to him. When only a few feet separate hunters and hunted, the harpooner, who has chosen a weapon gaged to the size of the reptile by the space between his eyes, lets drive his shaft into the back of the beast's head.

Usually the reptile sounds and runs, but unless he is very powerful and requires a second harpoon, his end is near. Usually after his first run he is drawn up alongside the boat, knocked insensible with an axe, jaw-bound with wire, and dispatched with a knife. If small, he is pulled into the canoe to be skinned; if large, he is placed on the bank till daylight when he is skinned on the hunters' return to camp.

Two methods of skinning are practiced. One is aimed to procure the belly portion and sides intact for making shoe leather. The other is intended to preserve the hornback intact for making luggage or fancy-goods leather. In either case, as soon as the skins have been removed they are rubbed with salt, rolled, and packed in burlap bales for shipment to the tanner. Although alligators are possessed of flesh claimed by the authority A. M. Reese to be edible, no use is ordinarily made of the carcasses, except to extract oil from some, because of its use for rheumatism.

Because of this fact, if for no other, it is doubtful whether alligator farms ever could be made to pay. Fourteen years are required for one of these saurians to grow to a length of nine feet. If after that time no other revenue is obtainable than that possible through the sale of the skin, amounting at best to but a few dollars, the utter impracticability of this scheme becomes apparent.

LANDING A 'GATOR

A scene in the Florida Everglades, showing a live alligator being hauled into a small skiff

Even in the case of shark and ostrich leathers, other products than the skin have value. Reptilian leathers are unique in that there are no commercial by-products offering sources of revenue to those engaged in obtaining the skins for their production.

The Far East provides the primary sources of the lizards that tanners have found suitable for leather making. Chief among these are the land lizard and the water lizard of India and the ringed lizard of Java.

In India all the members of many low caste families go in for capturing the land lizards. Having located the home of one, the natives wait by the lizard's hole until he comes up for a look at the world. Six months later that lizard's overcoat, stripped to preserve the belly intact and appropriately tanned and colored, is likely to be parading the streets in a city half way 'round the world.

With water lizards the technique is somewhat different. These reptiles, which are prolific, have abounded in the Sundarbans, that tract of forest and swamp fringing the Gangetic delta. So-called Gypsies, who live on their boats, hunt these lizards with such zeal that they have not hesitated to cut down great trees—the lizard's natural refuge—in order to make a kill. One of these lizards, when treed, can stick to his perch like a 'coon.

The more one looks at some lizards, the friendlier they appear to be. In Java they are actually household pets, behaving in much the same way as cats in this country. They kill rats and small snakes—a valuable service indeed. For that reason legislation already has been passed in Java limiting the number to be taken for their skins. Those whose fate it is to serve woman's fancy are caught by hand, swung by the tail until unconscious, and then dispatched by the native with a head blow.

SOME of these skins are dried in the shade to a flint-like hardness; some are given a preliminary tannage for preservation; still others are salted for shipment. In any case further treatment follows at the port where they arrive after passing through the rather elaborate network that has been spread for their collection.

By some caprice of Nature it happens that the snake whose skin is deemed most suitable for leather-making is harmless and quite easily captured. This is the watersnake, or karung, found most commonly in Java, Borneo, Siam, and the East Indian Straits Settlements. Unlike other snakes that are propagated by eggs and hatching, watersnakes give birth to as many as 24 little snakes at once. These approach their full length of from two and one-half to nine feet in about six weeks.

For this growth considerable food is required and it is while watersnakes are busily engaged in making a living for themselves that they are captured. Many are caught by natives who simply reach over the edge of the river bank and scoop them up as they glide by. Because they are slippery as eels the motion of the native has to be fast as lightning if he is to be successful.

As the demand for watersnake leather has mounted, this method of catch has given way in some areas to the use of seines. In either case, the reptiles are dispatched when landed, skinned with backs intact, salted, and so prepared for market.

It is said that the anaconda, also a water snake, sometimes attains a length of 30 feet and a girth of 40 inches. Because of the great size of members of this family of snakes, which includes the pythons and boas that are primarily land snakes, they have a coarser scale formation than the watersnake and are in somewhat less demand. Still they are tanned to an extent that has given rise to a commerce in their skins in India, Indo-China, and in South America, whence some boas come.

In general this snake—monster of the kingdom of crawlers—does his killing by coiling about his victim and crushing him. The art of capturing has to be modified accordingly, and although it varies from region to region, one method said to be followed by natives is to place a dead baby goat, known to be favored food, in the neighborhood of their victim. Once he has properly gorged himself, he is stupefied and in this state can readily be killed and skinned.

Not all reptiles are possessed of overcoats that are valuable for leather making. The king-cobra, perhaps possessed of the deadliest venom of any snake, is, however, numbered among those whose skins make a satisfactory leather and despite the religious taboos of Indian natives, a considerable number of these skins enter the international commerce. Perhaps it is because of these same taboos, which cause Hindus to venerate the cobra as a holy thing and to keep one under every sacred temple, that so little is known of the methods of the natives for their capture. Underfoot, deep in the jungle, rank with thick undergrowth, dank, silent, and steamy by day, made terrifying with the snarl of the tiger and the howl of the jackal by night, lives this destroyer of life.

All photographs courtesy American Museum of Natural History and Julian A. Dimock

LAUNCHING THE HARPOON

The harpoon consists of a long wooden pole with a suitable barb on the end. It is attached to a long strong line. The point of aim that is chosen is the back of the reptile's head

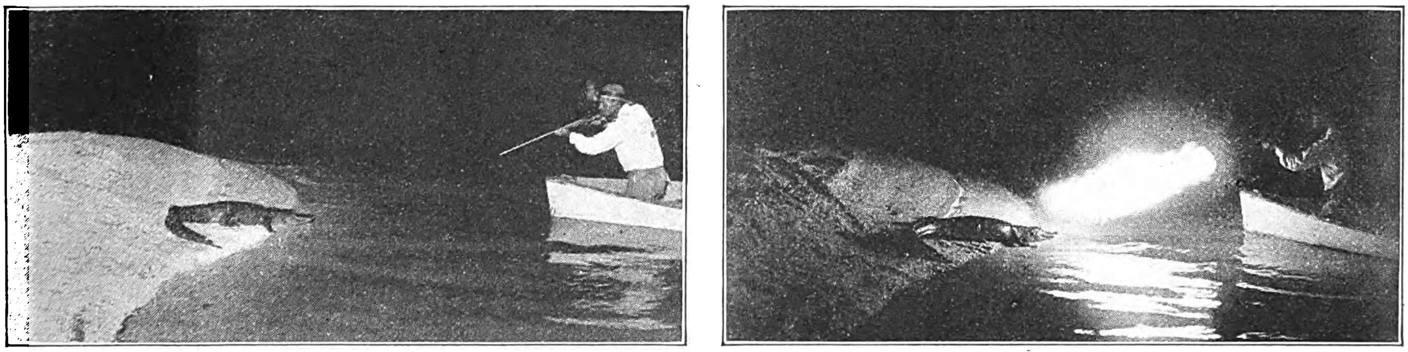
Apparently in the natural kingdom, lizards are among the successful foes of the cobra. Since the taking of so many lizards in India, loss of human life from cobra bites has increased to such an extent that government action may be taken to limit the season and therefore the number of lizards slaughtered for leather making.

The technique of catching reptiles varies but little in different sections of the world but, since the work is carried on mainly by natives, the methods are usually crude and inefficient. For example, where whole families engage in the work, relatively few specimens are captured. Were it possible for these natives to be under the direct personal supervision of white men, there is no doubt that they would use efficient traps, developed especially for the job in hand, and their catch would be unusually large. The result would probably be a glutted market and, following this, a shortage of reptiles.

Nature has given most reptiles adornment of beauty—although this term applied to the skins of some alligators and lizards as they arrive at the tannery might be questionable because of the mud-colored pigment that they carry. After all, it is the tanner's business to perfect nature's product, whatever type of leather he is making, and these reptile leathers constitute one outstanding evidence of his skill. Despite their light weight, the skins of lizards and snakes make one of the strongest leathers known, thickness for thickness. So far as coloring is concerned, the tanner works his magic by removing unsightly dark pigment, and substituting an aniline color in a style shade—without destroying the natural markings of the skin. Therein lies the marvel of his skill.

In one representative tannery 18 distinct operations are required for the conversion of these skins to leather. It is enough to say that after thorough cleaning, the processing includes scale removal—from snakes—and a softening and swelling of the skin substance to prepare it either for a bark tannage, a mineral tannage, or for a combination of both. Finally after the desired color has been given the skins, they are glazed to bring up the luster that makes this leather attractive to the eye. In this form the skins are sold—usually in terms of their width—to the shoe or leather goods manufacturer. He, in turn, makes shoes, purses, belts, and novelties to delight the eye and to win fashion's favor.

Because that favor is today so widespread, alligators, lizards, and snakes still living in their native habitat must watch sharply else they too will join the procession of their predecessors who have been taken from parts of the world where white men cannot live, to grace those other regions where women say "I want you" and insist on having their way.



NIGHT HUNTING WITH A GUN

When approaching alligators at night, they can be dazzled by a bright light, and will become so interested in it that they will remain motionless. In these two photos, the one at the left was taken by the light of the flare, and that at the right by the flash from the gun

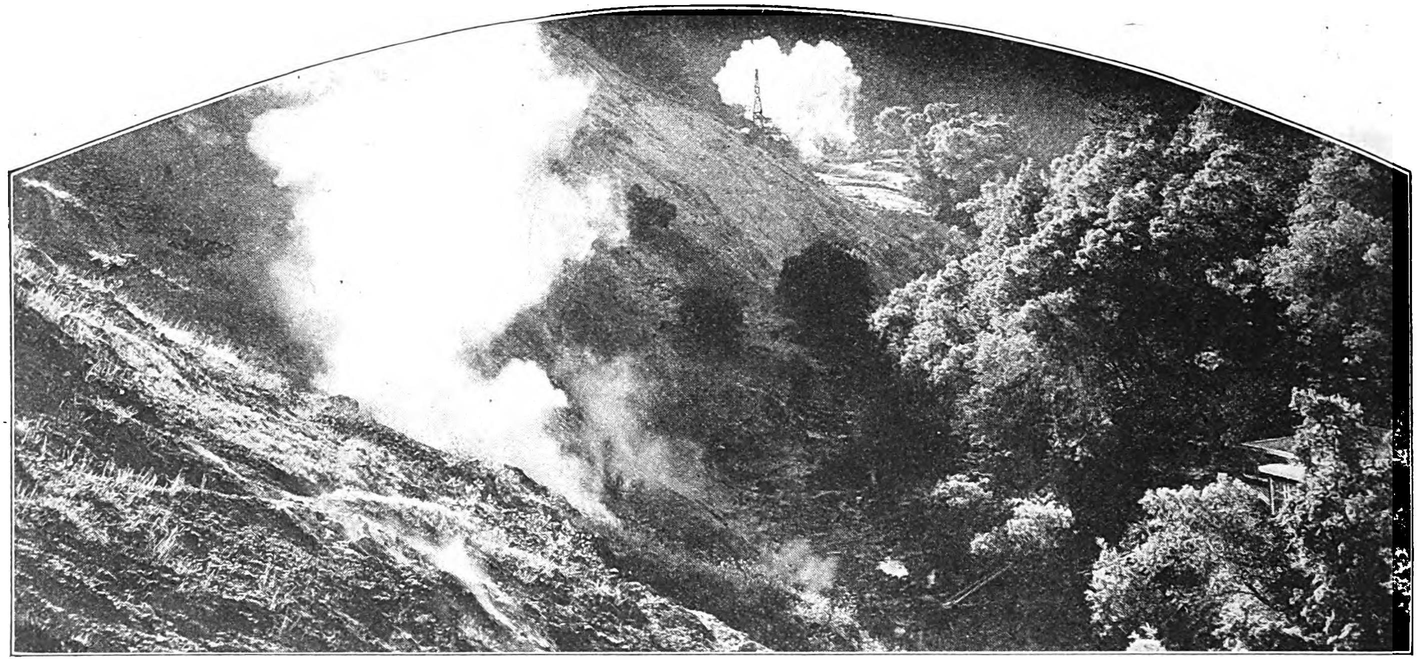


Photo by Arthur L. Day, courtesy the Carnegie Institution of Washington

HOT GROUND AT SULFUR CREEK IN THE STEAM-WELL REGION OF CALIFORNIA

Natural vents similar to those of Italy occur at "The Geysers," 60 miles north of San Francisco. Wells drilled there reach a depth of 650 feet, give steam pressure up to 275 pounds, and are rated at 1500 horsepower each. The area resembles the thermal area of Italy

Power From the Earth

The Steam Wells of Italy Tap a Large Source of the Earth's Inexhaustible Supply of Energy

By ALBERT G. INGALLS

THE age we live in is the Age of Mechanical Energy. Man has power in vaster quantities than he ever dreamed of before Newcomen invented the steam engine about 200 years ago. But how long will these stores of energy last?

We derive nearly all our energy from coal. Only a fraction comes or can come from water power, for there is not nearly enough water power in all the world to turn the wheels of industry. In the United States we now consume nearly a billion horsepower of energy. This is the basis of the common saying that each of us is boss over at least 30 tireless mechanical slaves.

There is enough coal in sight to last us about 1000 years at the present rate of consumption and, although nobody living need worry about the future source of energy when coal is gone, the question is as fascinating to scientific people as any question one could raise. This question has become more patent, also, since scientists have come to realize recently that the promise, so often held out a decade or so ago, that a way would doubtless soon be found to release the energy locked up in the atom, thus giving us undreamed of resources, is probably empty—an irridescent dream. It looks as if the sources of our future energy were only those which are now in sight.

These sources were classified all-inclusively some years ago by Dr. E. E. Slosson in his "Chats on Science," as follows:

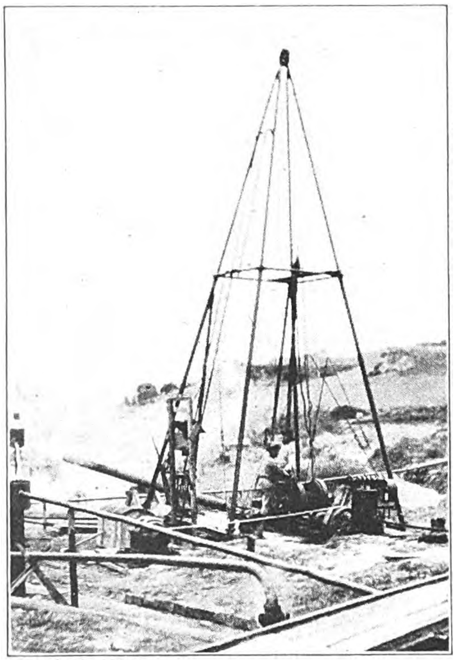


Photo by the author

DRILLING A STEAM WELL

A section of tubing for diverting the sudden uprushes of steam shows at left

I. Non-solar
  (1) Tides
  (2) Internal heat of the earth
  (3) Internal energy of the atom

II. Solar
  (1) Direct solar engines
  (2) Indirect
  A. Physical
  (1) Winds: by sails, windmills
  (2) Waterfalls: by waterwheels
  (3) Solar tides and waves
  B. Chemical: oxidation of carbon and hydrogen
  (1) Internal: food
  (2) External: fuel
  (a) Gaseous: natural gas
  (b) Liquid: petroleum, vegetable oils, alcohol
  C. Solid
  (a) Coal: ancient, limited
  (b) Wood: modern, continuous

Such a list of sources looks quite imposing. But a blue pencil drawn through those which are inadequate, such as waterfalls, food, and wood; those which are mainly impractical, such as tides, the internal heat of the earth, solar engines, winds, and waves; or unavilable, such as the internal energy of the atom, would leave the list in a

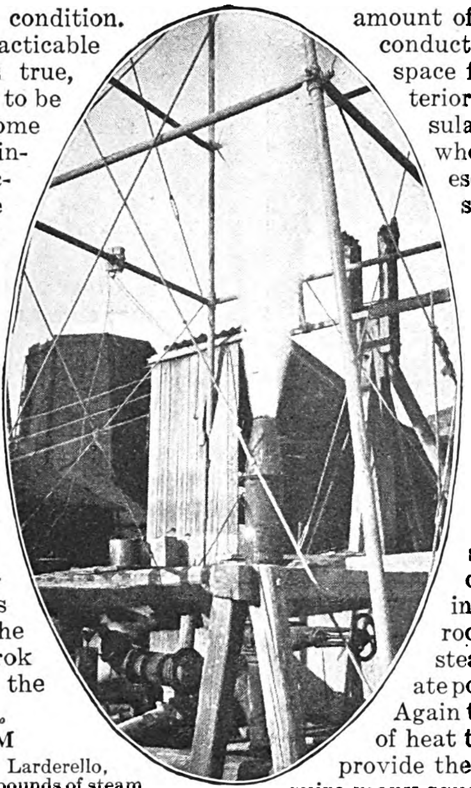


Photo by Società Boracifera di Larderello

MEASURING STEAM

This powerful well at Larderello, Italy, gives over 125,000 pounds of steam per hour at 14 pounds pressure per sq. inch

greatly shrunken condition. Some of the impracticable sources may, it is true, turn out at any time to be practicable, due to some new discovery or invention. (By "practicable" is meant the ability to turn out *economically* a large part of the billion horsepower we use.

There is a special fascination in the problem of the earth's internal energy. This has already been harnessed in a few very limited, almost unique localities where it manifests itself controlably. This we shall see later in the present article. Orrok has calculated that the heat content of one cubic mile of earth magma over a range of 3000 degrees at only 10 percent efficiency is equivalent to about 60,000,000 horsepower for one year. The earth has a volume of about 250,000,000 cubic miles, most of which is believed to be hot. Such calculations as these are rough, of course, but Hodgson states that the heat stored within the earth is 30,000,000 times as great as that stored in all the earth's two trillion tons of coal. Even after making the most reckless allowances for loss and waste we would still be left with enough subterranean energy to run our mechanized civilization as long as anything human mattered—if only we could find a practical, economical and efficient way to get it out.

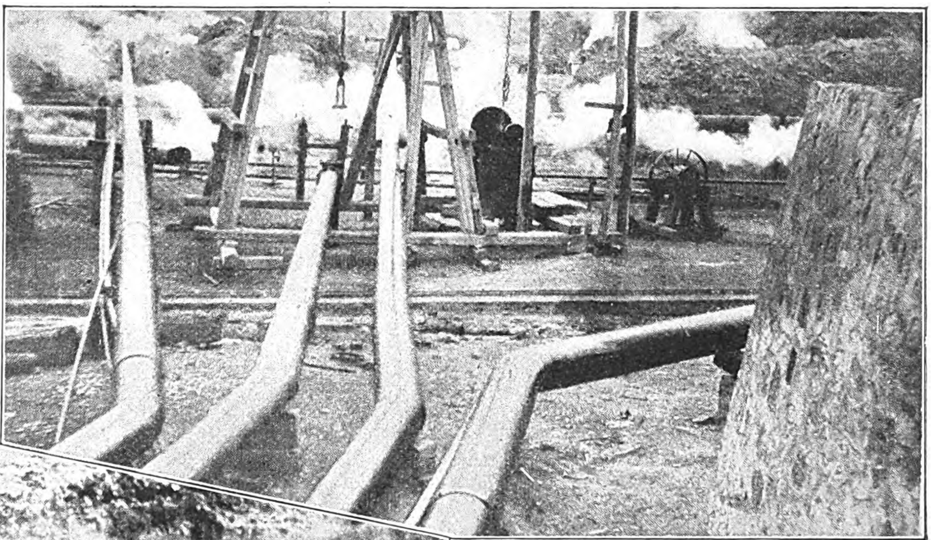
The chief difficulty in getting at this immense supply of energy is the poor heat conductivity of rock. A certain amount of heat is constantly conducted outward into space from the earth's interior but so good an insulator is rock that the whole amount of this escaping heat would suffice to melt only an eighth of an inch of ice in a year. Sir Charles A. Parsons has advocated a plan for getting at some of the heat from farther within the earth where a larger temperature gradient could be had. His plan is to sink a shaft 12 miles deep and, pouring in water, let the hot rocks turn it into steam, and then generate power from the steam. Again the slow conduction of heat through rock might provide the rub—it would require many square feet of surface within the shaft to generate one horsepower continuously by this method. Its practicability is debatable.

The vast stores of energy within the earth seem, then, to elude us—at least for the present. We must be content to harness the comparative driblets, large nevertheless in an absolute sense, which reach the surface by natural means. Practical recovery of such power is already taking place in at least two localities, chief of which are Sonoma County, California, and Tuscany in Italy. Other regions—Oregon, Alaska, Chile, Bolivia, New Zealand, Japan, Iceland—give promise.

The noted thermal region of Sonoma County, California, has been described previously in this journal (January 1925), and was subsequently (1927) described in detail by Allen and Day in "Steam Wells and Other Thermal Activity at 'The Geysers,' California" (Publication 378, Carnegie Institution of Washington, Washington, D. C.). The somewhat similar thermal region of Italy has never been adequately described to the readers of this magazine. On this account it was visited by the writer some months ago. The California wells have not yet been exploited commercially but the Italian wells have.

NOT only is the natural steam in the Italian thermal region employed to generate about 10,000 horsepower of electricity, which is transmitted at high tension to Florence and other cities on the power-line network of northern Italy, but the by-products, mainly boric acid, which are derived from the large admixture of gas that comes up out of the earth with the steam, and their manufacture into a large variety of products such as borax, borated talcum powder, soap, and so on, are the basis of a good-sized industry. There is something especially fascinating in the realization that all these valuable things come up of their own accord out of a pipe that taps an apparently inexhaustible supply from somewhere down in the bowels of the earth. The Italian wells have enriched their owners.

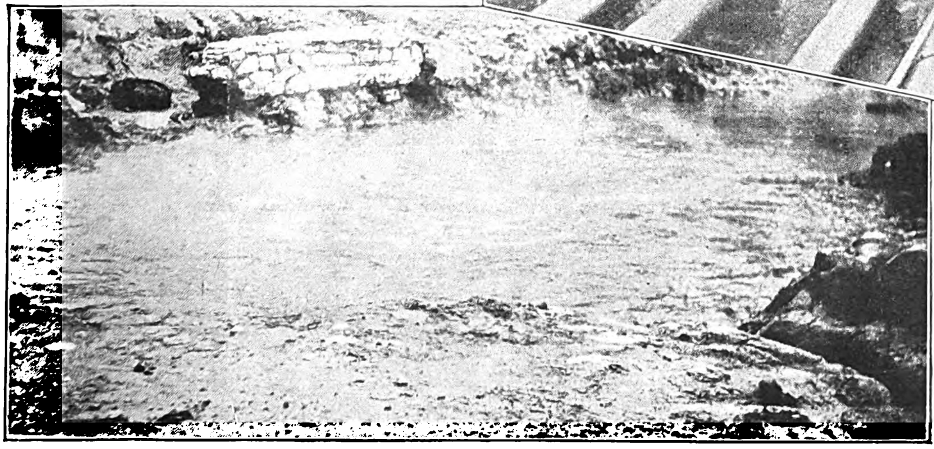
The thermal region of Tuscany covers an area of about 100 square



BRINGING IN THE STEAM ➤

Insulated tubing conducts the steam from the several wells to the power house

Photos by the author



⮜ NATURAL STEAM SPRING

This pool is typical of what was originally found at Larderello; it remains untouched miles. This is divided up into eight local areas, all falling within a circle roughtly about 15 miles in diameter. The area has been developed by Prince Piero Ginori Conti, a well-known Italian industrial chemist. Originally, before the wells were drilled, the natural manifestations took the form of fumaroles or natural steam springs. The Italians call these springs *soffioni*, that is, blow holes or "hissing" holes.

Prince Conti first drilled a well and made experiments with a 15-horse-power engine connected direct to the tubing. This worked satisfactorily, generating power to light a few small electric lamps. Later a 250 kilowatt power plant with turbo-alternators was installed, but instead of using the steam direct, in which case the gases mixed with it would have ruined the condensers, it was used for generating pure steam from another supply of water. This installation proved satisfactory and three 2500-kilowatt units were installed and several more wells were drilled.

THE technique of well drilling against increasing heads of natural steam had to be developed mainly out of experience. Rotary drilling methods are employed and the uprushing steam is diverted to one side. One of the photographs shows a well being drilled. These wells vary in depth from 200 to 750 feet, and as the depth is increased the violence of the steam is likewise increased. The drillers develop the quick starting technique of a 9 2-5 second 100-yard-dash runner, as sudden rushes of steam and hot water come without warning.

The combined steam output from about 12 wells amounts to more than 250,000 pounds an hour, although at less than atmospheric pressure, and is conducted to the powerhouse several hundred feet distant through insulated pipes. Owing to the invention of a simple device called a "depurator," 90 percent of the admixed gases are at once separated from the steam and, this being accomplished, it has been found unnecessary to use the steam indirectly for generating pure steam, as the small remaining percentage of gases does not damage the turbines. The turbines are of the Parsons or reaction type with central feed and double flow. A special alloy is used for the blading to prevent undue corrosion.

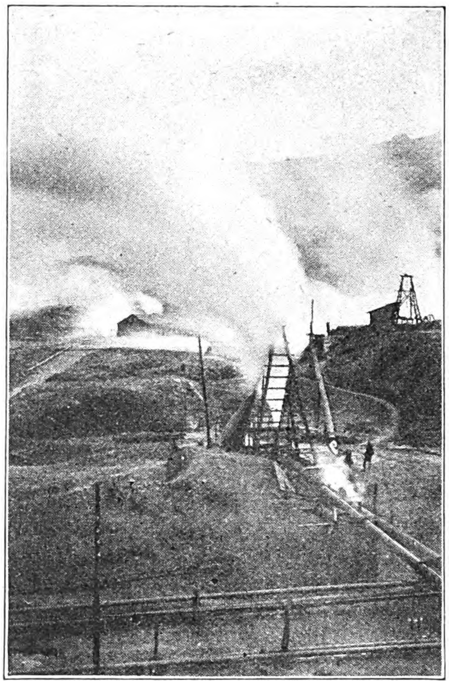


Photo by *Societa Boracifera di Larderello*

BLOWING OFF A WELL

The roar of a well when only partly opened was unearthly and literally awful

With the steam floating around the landscape in small clouds, the smell of hydrogen sulfide everywhere, and the truly infernal racket of one of the wells blowing off steam when purposely opened for demonstration purposes, one wonders how Dante, the Italian poet, ever missed visiting this place when writing his vivid description of hell.

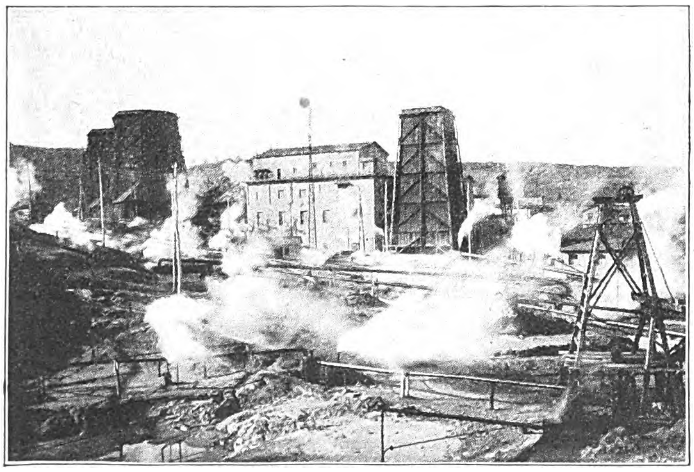
In addition to the plant at Larderello there are several others, all under the same ownership, at various villages within a radius of a few miles, but Larderello is the original plant and the main one. In all, three power stations are in operation. The current generated by the turbo-dynamos is stepped up to 38,000 volts and conducted to the transmission network of northern Italy, running in parallel with a number of hydro-electric plants.

To recover valuable chemicals in addition to energy from steam rushing out of the earth seems like "eating one's pie and having it too," yet this is done and Count Giovanni Conti, heir of Prince Ginori Conti, stated that the chemical end of the development was regarded with as much solicitude as the power.

THE ratio of gas to steam varies from one spot to another, from 4 to 6 percent in weight. The composition of the gases which accompany the natural steam from the bottom of the wells is about 92 percent carbon dioxide, the rest being hydrogen sulfide, methane, nitrogen, oxygen, hydrogen, and small quantities of argon and helium. Mineral substances contained in the waters resulting from condensation of the steam at the steam springs are boric acid (about 1.5 parts per thousand) and salts of calcium and magnesium.

Borax is made by mixing crude acid with water and carbonate of soda in pans, warming with natural steam and allowing the extracted borax liquor to crystallize.

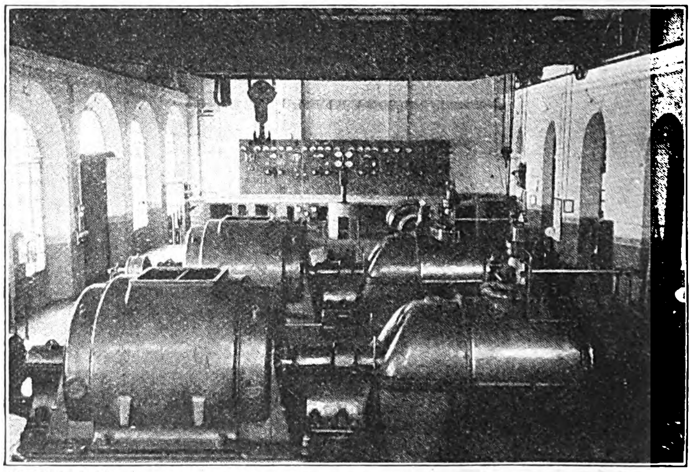
Other products are also manufactured. The carbon dioxide is liquefied and sold, or converted into carbonate of ammonia. An hour's circuit of the factory at Larderello, with its rooms allotted to the mixing of borated talcum powder, the preparation of borated soap and borated cosmetics will suffice to convince the visitor that here as well as in the Chicago stock yards "everything is utilized but the squeal."



Photos by *Societa Boracifera di Larderello*

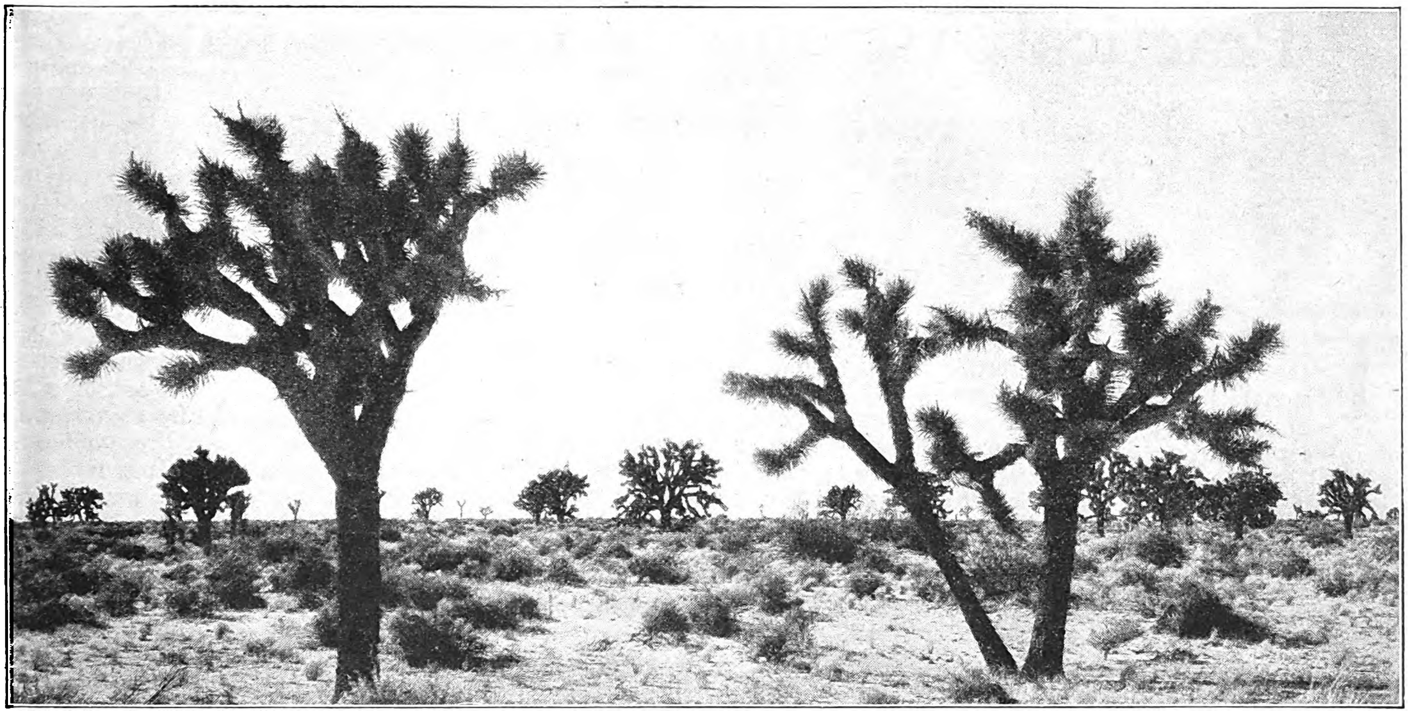
THE POWER PLANT AT LARDERELLO

The power house is in the center. The three remaining objects are cooling towers for the condensing water. Note thermal soil



THE INTERIOR OF THE POWER PLANT

This shows two of the three 2500-kilowatt turbo-alternater units. The power generated is "shipped by wire" to Florence and Pisa



Photographs courtesy All Year Club of California

"BANDS OF WORSHIPPERS . . . IN CONSTANT DEVOTION"

The common name of the Joshua tree—praying tree—was accorded to it because of its usual devotional attitude when viewed from a distance. Here are Joshuas in their desert home in California. Notice in particular the appearance of those on the horizon

Praying Trees of the Desert

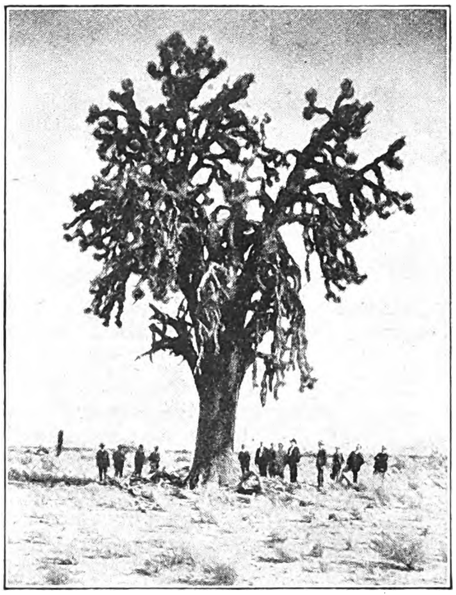
The Friendly Joshua Tree Lends a Spirit of Hopefulness to the Weary Desert Traveler

By BRUCE McDANIEL

THE Joshuas, or praying trees as they are often called by weather-bitten prospectors, are the most striking dwellers of the great California desert, and as such are of especial interest to tourists. Their shaggy limbs, sheathed in grayish-green dagger-like growths, are usually raised toward the sky; and, through the wriggling heat waves of day, the eerie glow of night, in the distance they appear to be bands of worshippers engaged in constant devotions to the sun and moon. After having fought their way through the desolate canyons and shimmering playas on their way westward, the Mormons suddenly came upon these praying trees, and it is believed, bestowed upon them the name of Joshua trees.

SHUNNING the lower valleys—where the creeping dunes move slowly past the spiny chollas, the water-barrel and hedgehog cacti, the bladder-pods and brittle bushes—the sturdy Joshua seeks the coarser soils of such places as Morongo Valley, Lost Horse Valley, Antelope Valley, and the undulating portions of the Mohave desert north of Cajon Pass in California. With the silver-berried junipers, the doughty creosotes, and hardy manzanitas clustered about its feet, there it lives to a ripe old age despite the ravages of thirst, the lashing of the blazing sun, and the march of man.

In the early desert spring, the tips of its twisted limbs burst into bloom. Huge spikes of greenish-white blossoms proclaim anew that the wise old Joshua has sent its roots in search of water, and found it. Weeks pass. The withering petals drop and the big seed-pods form. Within each of these several-sectioned pods packed tightly one above the other, are many thin black seeds with white hearts. The fleet-footed desert antelope, and other wary rodents, dare to worm their way up the limbs past the barrier of spikes, to feast upon the contents of these dried pods. Hour after hour, these canny denizens scamper up and down the Joshuas and carry the seeds to their nests, which are usually hidden beneath the trunk of a fallen Joshua, or in the shadow of a scraggly creosote, or among the roots of an old sage.



AN OLD TIMER

This specimen of the praying tree is to be found in the Antelope Valley of California

THE Joshua tree is of some value to the desert nomad. Its greener shoots may yield a scant cup of precious water, its withered limbs may serve as fuel, its trunk might form a portion of a humble shack for some hopeful homesteader, and often one finds relief from the sun in its sparse shade. The Joshua is a friendly tree. Its spirit of hopefulness more than once has encouraged the wayfarer whose heart has been weary and whose hopes have been broken by the parching winds and biting sands. Before man first came upon the desert, the Joshua was lifting its prayerful arms to the sun and moon.

Practical Astronomy for Amateurs

How the Amateur Astronomer Is Helping to Observe and Calculate the Moon's Motions

By ERNEST W. BROWN[*]

Sterling Professor of Mathematics at Yale University
Corresponding Editor, the SCIENTIFIC AMERICAN

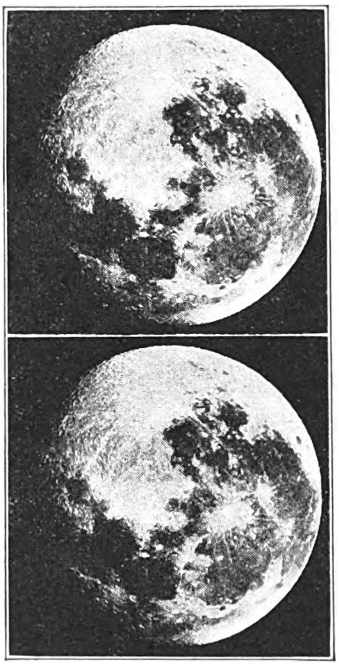
THE chief difference between the amateur and a professional astronomer is often one of occupation only, and not one of expert knowledge. The professional astronomer makes that subject the main object of his work and the amateur the main object of his leisure. Hence there is nothing surprising in the fact of co-operation between the two groups, for the purpose of advancing our knowledge of the heavens. The main difficulty is to find lines of investigation which can be followed usefully when the hours of leisure are occasional. Three of these lines are the observation, the reduction, and the prediction of occultations of stars by the moon.

An occultation is the disappearance of the light of a star covered by the moon between the observer and the star. The observation of an occultation is a record of the instant of time when the limb of the moon blocks out the light of the star, or of the later instant when the star reappears from behind the opposite limb. From two such observations made near to one another the position of the center of the moon at any instant near the times of observations can be calculated.

FROM the point of view of the observing astronomer this is one of the simplest of all observations which can be made on objects in the sky. If he has a telescope of sufficient power to see the star well—and the small instruments used by most amateurs are quite sufficient for the brighter stars—his observation is independent of any defects of his telescope. Even with the largest instruments the star disappears within a small fraction of a second when the sky is clear of clouds and haze.

The first question which will naturally be asked is the accuracy with which the instant of disappearance or reappearance must be recorded. The answer is that for the chief needs of the subject at present it is sufficient if the event is obtained to the nearest second of time. Thus, as far as the personality of the observer is concerned, it is only necessary to be able to record an event which is seen by the eye, while with the ear the beats of the pendulum of a clock are being counted. A little practice—which can now-a-days be obtained by trying to record the changes of the traffic lights in the streets—will soon give the observer the needed facility. Of course, if he possesses a stop-watch, the observation is evidently much easier, because it is not necessary to do any counting of seconds.

The final need is some means of obtaining the time accurately. In these days of wireless time signals sent out at least twice a day, all the observer requires is a chronometer or clock which will hold its rate accurately for some 12 hours. Even this can be dispensed with if the observer can get into telephonic communication with some near-by observatory within a short time of making the observation. It is necessary that the observer should know his geographical longitude and latitude within two or three seconds of arc, but this is obtained once for all without much difficulty, by referring his position to some spot within a few miles which has been a accurately located by the Coast and Geodetic Survey.



A LUNAR OCCULTATION

Above, a star is about to disappear suddenly ("immersion") behind the moon; below, it as quickly emerges again on the opposite side

The calculation of the position of the moon from the observation is ordinarily one for the mathematical astronomer. This process is called the "reduction" of the occultation. It has been simplified to a set of rules which can be followed by anyone who knows a little elementary trigonometry and understands how to use tables of logarithms. A good computer who has learned the rules can perform a reduction and check the work in about an hour. A beginner will naturally take longer, but practice soon gives rapidity and ease in performing the calculations.

A considerable number of amateur astronomers in America, England and other countries have undertaken this work of observing and reducing occultations. Some observe, others who have not the necessary opportunities to observe, reduce, and still others observe and reduce occultations. Some three years ago the American Association of Variable Star Observers—the "A.A.V.S.O." as it is now everywhere known in astronomical circles—began to extend its activities beyond those which its name implies, and under the enthusiastic leadership of Mr. J. E. G. Yalden, of Leonia, New Jersey, formed a committee which has now grown into a section, to deal with occultations. The first task of the committee was to secure members who were able and willing to reduce occultations. Many astronomers, professional and amateurs, publish observations from time to time: a few of them make observations available for discussion by reducing them; and it is this work which was and is most needed.

AT the same time, the British Astronomical Association, which under its abbreviated title, the "B. A.A.," is a society in which amateur and professional astronomers co-operate in various ways for the advancement of astronomical science, formed a section to deal with occultations. Dr. L. J. Comrie, who some years ago was working in the United States and is now assistant superintendent of the British Nautical Almanac Office, gathered together a number of members of the B.A.A. and started them on the work of predicting occultations.

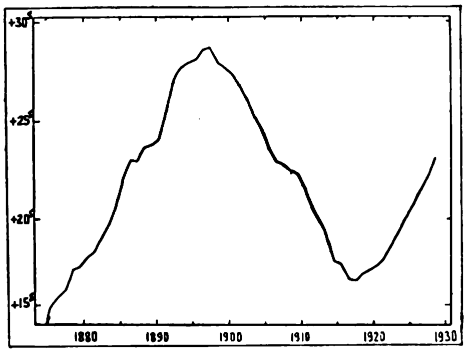
Ordinarily, the times when occultations of bright stars will occur are predicted only for the national observatories. These predictions are necessary so that the observer may know when to go to his instrument. The predictions are furnished with an accuracy of a minute or two, so that the observer need not waste a lot of time waiting for the event to occur. The British Committee is now covering nearly the whole of Europe and some regions in other countries with annual predictions. Elsewhere, and particularly in the United States, observers had in general to make their own predictions, but this matter is now being taken up more systematically.

---

[*] See "Among Our Contributors," page 373.

By a method devised by Dr. Comrie a single set of predictions can be made to serve for an area some 600 miles in diameter, so that a few such sets will cover a large field. Within the last year, the B.A.A. has added the work of the reduction of occultations to its program, this being taken care of by its computing section under the chairmanship of Mr. T. Whitwell. For convenience and to avoid duplication, the B.A.A. takes care of all unreduced occultations observed within the British Empire, while the A.A.V.S.O. looks after the remainder.

There are others who are not directly affiliated either with the A.A.V.S.O. or the B.A.A. who are adding to the story. One of these, Dr. J. Moir of Johannesburg, South Africa, furnished a long list of observations in 1928 which was received a few months ago. His recent death is a distinct loss. His contributions were stimulated by the emeritus director of the Union Observatory in that city, Dr. R. T. A. Innes, who was in one sense the source of the present campaign, since it was he who in 1923 started the observation and reduction of occultations on a large scale.



THE LAST 53 YEARS

Figure 2: In 1928 the earth was 32.1 seconds ahead of its average rotational motion during the last three centuries

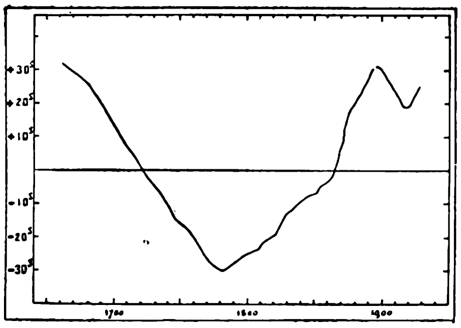
Then there are several teaching observatories which have made the observation and reduction of occultations a part of the work which is assigned to students. In this way the student not only learns several important parts of his subject, but has the satisfaction of feeling that the work he does is a permanent contribution to the science.

How the work has grown may be judged from the fact that in the first year of the campaign, which dealt with the observations made in 1926, 160 reduced immersions were available for discussion, 62 of which were calculated by members of the A.A.V.S.O., by students and by others who volunteered to help. In 1927 the list had grown to 418 and it contained nearly every observation published or communicated by letter which could be utilized. Some 250 completed results have already been received for the year 1928, and there seems to be little doubt that the number for that year will equal or surpass that for 1927. Additional offers of help from volunteers are being continually received and there is now much less difficulty in taking care of the observations than was experienced last year.

A NEW and valuable addition to the campaign is the formation of an occultation section of the Bond Astronomical Club in Cambridge, Massachusetts. At present this section is engaged in collecting and reducing the observations which were made in 1924, a year in which the reduced occultations were fewer in number than was needed to make a good determination of the mean for the year. When the club has completed this work, our knowledge of the apparent position of the moon at any time since the beginning of 1923 will far surpass in accuracy that of any previous year.

Since this article is mainly concerned with the help which the non-professional astronomer is giving to finding the apparent motion of the moon, no mention has been made of another class of observation which is made a regular part of the program at the national observatories of Greenwich and Washington. At these places the observer notes the exact instant at which the moon crosses the meridian, that is, the instant when it is exactly south of the observer. On account of the difficulty of observing the moon when it is close to the sun, and the frequent cloudy nights, only about 100 such observations are obtained at each place in a year. Greenwich has kept the record regularly for 180 years and that observatory gives us our chief source of information for the motion of the moon during the past two centuries. In the final discussion of the motion at the present time these observations are included, and by comparing the results with those deduced from occultations we expect to learn more about the errors by which all such observations may be affected.

Articles in previous issues of the Scientific American have described the main object of this work, which is now the determination of the rates of length of the day. What we get from the observations is the apparent position of the moon, on the assumption that the length of the day is constant. This assumption means that the rate at which the earth turns on its axis does not change. Now we know from the law of gravitation just how the moon ought to move in the sky, and it has been shown with a considerable degree of probability that the difference between its theoretical rate and its observed rate is due to changes in the rate of rotation of the earth.

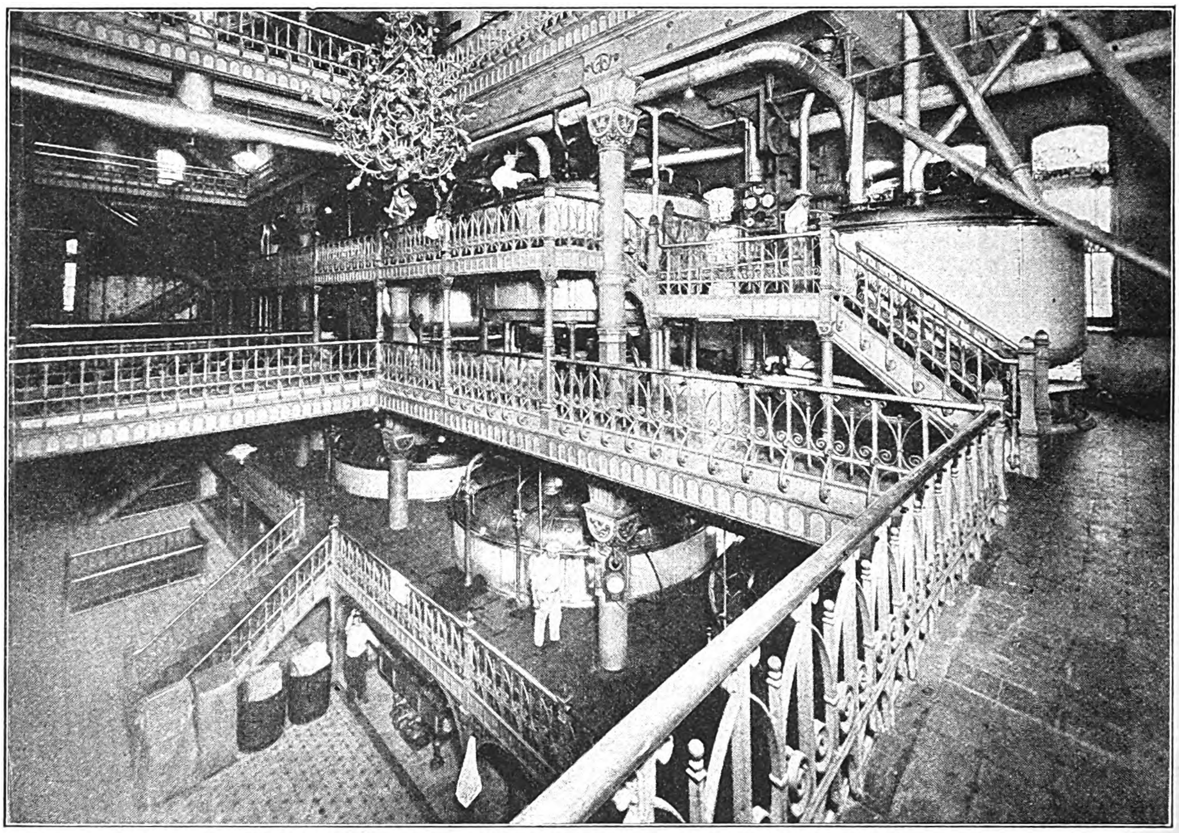


CHANGES SINCE 1740

Figure 1: Irregularities in the earth's rotation derived from the moon's motion

During the last 300 years these changes have been oscillating. The curve (Figure 1) seems to show a period of some 250 to 300 years. But this period is quite rough. There are minor fluctuations of very considerable extent, which cannot be predicted. A feature of the curve is the sudden changes which appear to be characteristic. (Figure 2), which gives the curve for the last 53 years on a larger scale, shows one about 1898 and another near 1917. If one might judge from the past another such change is due within the next 10 years. But predictions of these changes have had a bad habit of coming to grief and this one is mentioned with great hesitation, and only because it adds to the interest of the work to look for an expected event, even if the expectation may be disappointed. At the present time, the earth is rotating a little faster than the average and the rate seems to be increasing. If we may judge the future from the past—and there seems to be no other guide at present—this rate should begin to decrease within a few years and should continue to do so until the earth is rotating more slowly than the average.

The total changes known with any certainty in the past are very small: the greatest known is one in which the apparent loss or gain of time was about one second in a whole year. This is only about one part in 30,000,000. Small as this amount is, we can now detect much smaller changes. With the new material derived from the occultations there should be no difficulty in detecting changes from year to year of one part in 300,000,000 in the average length of the day.



THE HEART OF THE INDUSTRY—THE BREW HOUSE

In the upper tanks the malt and rice are "mashed" with water. The mash then runs into straining tanks where the starchy material is changed into sugar. The liquid is filtered, hops are added, and all is cooked in kettles

An Outlawed Industry 'Comes Back'

How a Great Brewing Establishment Was Crippled by the 18th Amendment and How It Emerged Triumphant

By A. A. HOPKINS

AFTER the advent of prohibition, the brewers did not all come back; some released high-powered beer and the heavy hand of the law withheld the product at the source; others manufactured ice and ice cream and others went into the discard. The present article deals with a remarkable comeback staged by the largest brewery in this country. Backed by capital, fortunate real-estate investments, and the control of basic materials, this brewing company was able so to modify its plant that nationally needed products could be made, with few changes in basic equipment. It is now in a figurative sense engaged in making "plowshares" instead of the outlawed beverage which once flowed in these United States.—*The Editor.*

A GREAT deal of water has flowed under the Eads bridge since January 16, 1920 and a great deal of the money of Anheuser-Busch was dammed up at the source when the Eighteenth Amendment went into effect. Trains still go over the great bridge; the Mississippi still runs under it; and the great brewery still carries on. It is, however, a wonderful survival of, perhaps not the fittest, but a good example of the fit. Possibly other breweries may have done practically the same thing, but on account of its size, the St. Louis showplace is a most conspicuous example of an industrial "comeback" after a great and unforeseen disaster. The wicked child of malt and hops required great spaces for economical manufacture, storage and distribution, and the plant referred to occupied 142 acres of ground, or 70 city blocks, outside of its 36 branches and 400 distributors. Fifty thousand cars a year were necessary to carry the amber fluid to the thirsty ultimate consumer. Six thousand persons made the liquid content and sent out a million bottles a day after it aged for four or five months in the great stock houses which held some 650,000 barrels.

It was found necessary to have warehouses and cold storage plants, and, in some of the larger cities, bottling establishments to conduct the former business properly. This necessitated the acquiring of real estate both for branches and distributors, and in order to handle the product as expeditiously as possible, sidings had to be built so that cars could be switched right into the buildings.

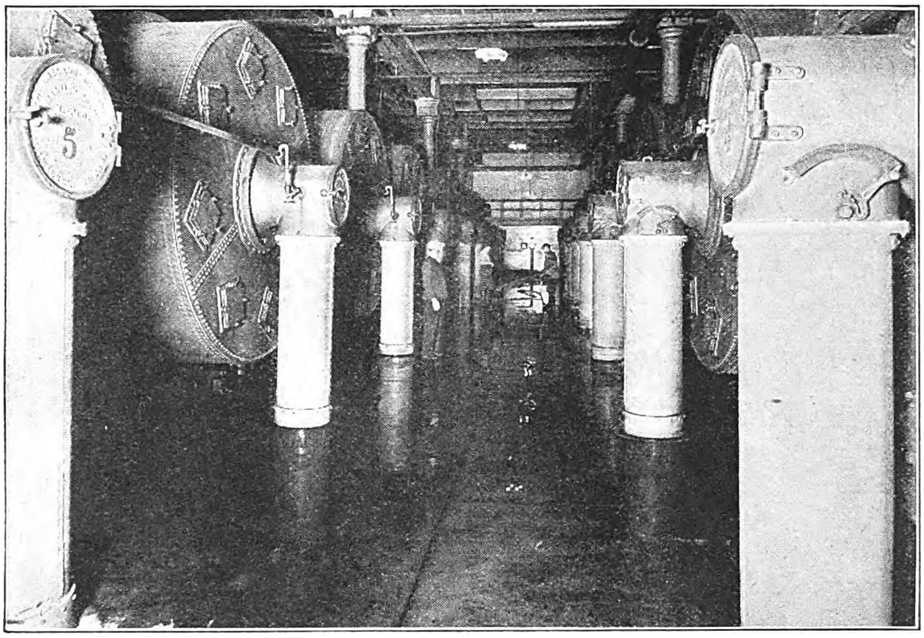
For economic reasons these properties were generally purchased on the outskirts of towns and cities to get proper railroad facilities. In the fullness of time cities built up and around the properties, thus enhancing the real-estate value of them enormously. Now this company has many millions of dollars worth of valuable real estate located in towns and cities throughout the entire country. The section of St. Louis where the great brewery is situated was far from being a deserted village when the writer had a "private view" of the industries last October. The stately brew house operates as of yore, but of course the alcoholic product must be less than ½ of 1 percent instead of the 4 to 4½ percent in the days when "beer was beer" and not a "cereal beverage."

Some of these huge buildings have now been leased to other industries, but the more important ones are still helping to carry on "business as usual," although the business has been somewhat metamorphosed by reasons not under the control of the board of directors.

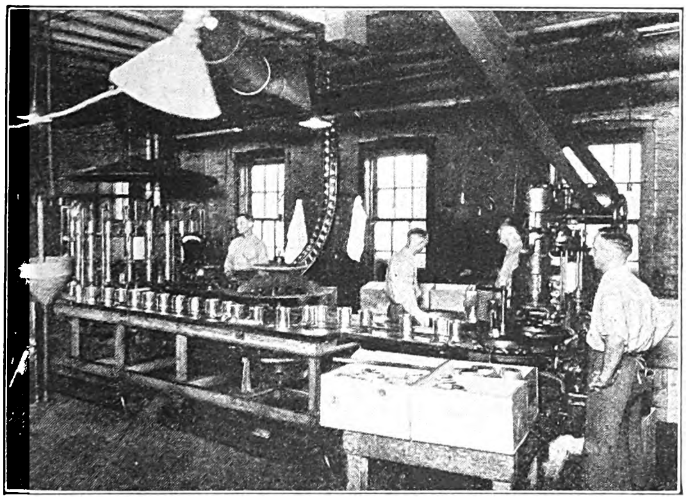
SINCE prohibition, this brewery concern, like the lesser ones, has found it rather hard sledding to keep the big establishment going. They went into a number of ventures which were flat failures, but now daylight shines, after a long night, on corn syrup, non-alcoholic cereal beverages, malt food tonic, glucose, ginger ale, and especially baker's yeast, to name a few of the ten products to which the plant is now dedicated.

Aside from the important question of real estate, there is another industrial foundation on which this remarkable change depended. This is the control of basic materials. Coal is basic and coal for the furnaces of the great 12,000-horsepower plant comes from the brewery-owned mines, and the fuel also helps heat part of St. Louis as well. The coal comes in over two brewery-owned railroads. One of these railroads serves 275 other St. Louis industries. The same brewers put on the market refrigerated trucks which are used for all kinds of transportation of perishables. It was not much of a step to produce motor bus bodies and this was done. Diesel engines are made at a brewery-owned plant which has been building these engines for over thirty years.

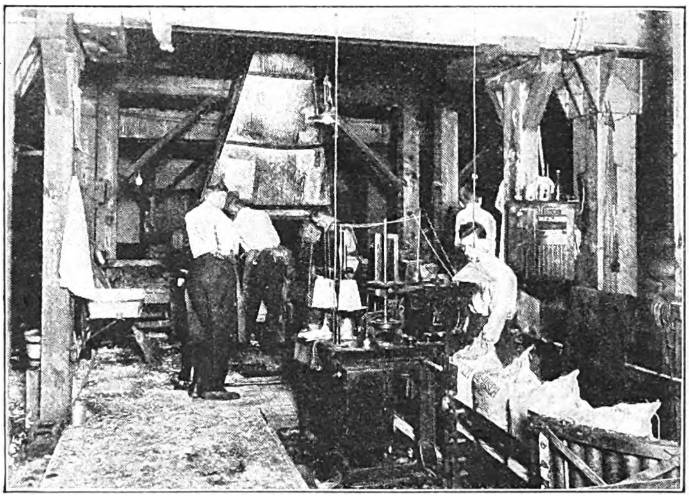
The question of "how they did it" seems to be answered as follows: the


A BASIC STEP—THE MALT HOUSE

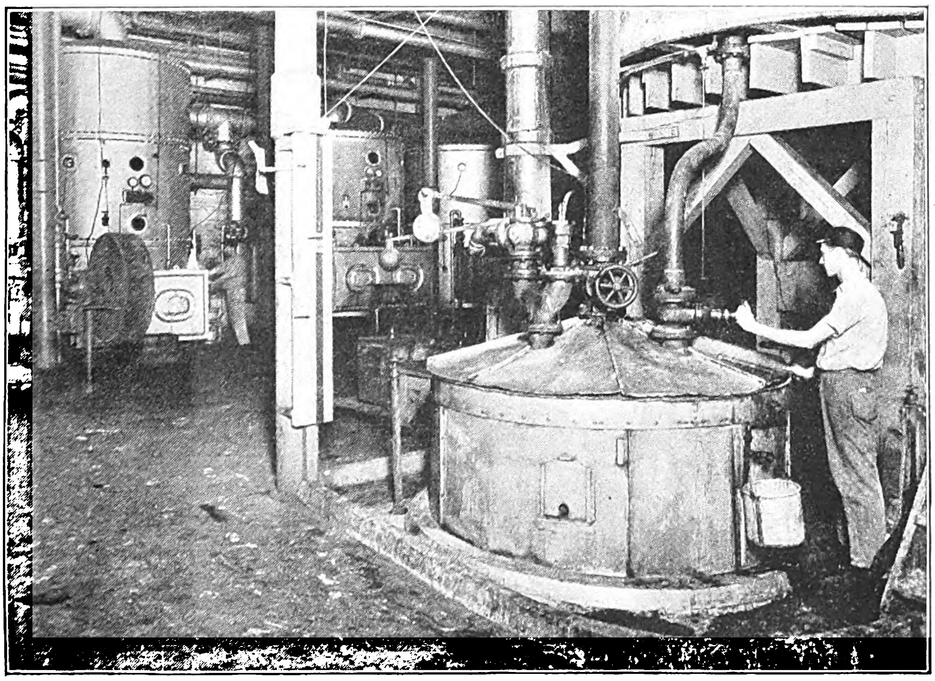
In the old method of malting, grain was sprouted on floors but uniform germination was impossible. In the pneumatic process illustrated, accurate results are quickly attained


CANNING MALT SYRUP

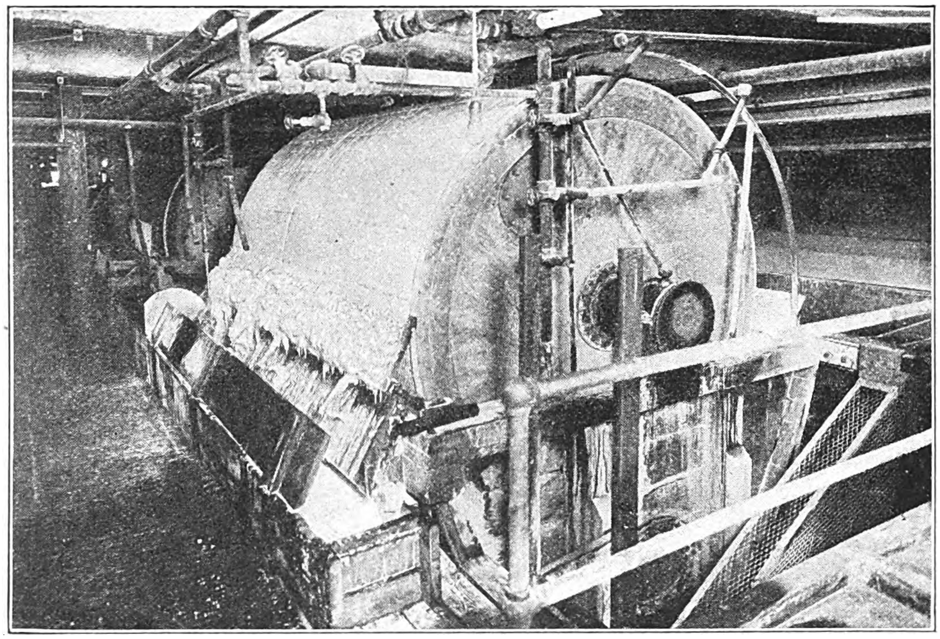
In malt-syrup manufacture, malt only is used. The "wort" from the malt mash is concentrated in vacuum evaporators and canned


BAGGING CORN SUGAR

The corn sugar is crystallized in large pans and is then chipped or broken up and packed in 100-pound bags preparatory to shipment


◄ BLOWING OFF STARCH

At the right is a converter. The triple-effect vacuum evaporators are at the left



FINAL WASHING OF STARCH

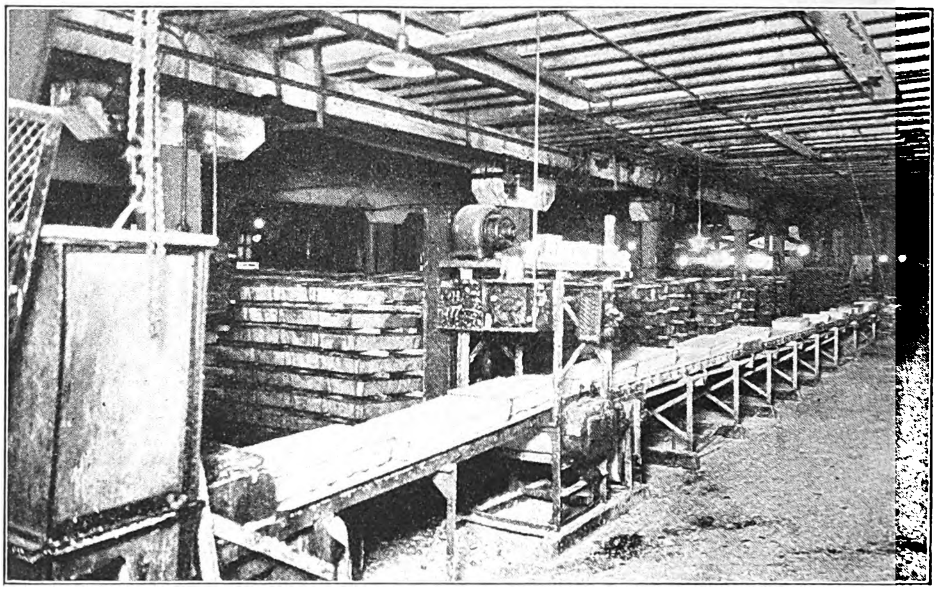
The starch is produced from corn which is steeped and ground, settled on tables, further purified, and converted into sugar. Our illustration shows an Oliver filter for final washing

eggs were not all in one basket; there was an ability to grasp the essentials of public demand; the company had control of basic industries, ownership of real estate, and, most important, money to tide over the trying period of readjustment. Such is almost a fairy tale of business, but facts have displaced the fairies and we have outlined one of the most fascinating stories of American business.

THE malt house is one of the basic steps in any brewing industry. Here great drums containing 600 bushels of steeped barley revolve slowly while humidified air is forced through, causing the barley to sprout. This takes about five days. The green malt is subsequently dried and stored as barley malt.

The many-storied brew house is an imposing structure. Here malt and rice are "mashed" for cereal beverages. Only malt is used for malt syrup. The amount of material for each brew approximates 15,000 pounds, which is mixed with water. The mash is run by gravity into straining tanks in which the starchy material is changed into sugar which forms a saccharified liquid called "wort." This is separated from the spent grain and boiled with hops in the great brew kettles. After the hops are separated the wort is ready to be fermented by the addition of yeast which changes the sugars to carbon dioxide and alcohol. The latter is lowered to the legal limit, producing a "de-alcoholized" beer *sans* kick.

For malt syrup the wort is pumped to a refinery where triple vacuum evaporators concentrate it to a thick syrup. Malt tonics are made similarly to cereal beverages, but for malt tonics caramel or color malt is used in addition to malt. In the manufacture of corn sugar, corn starch is the essential material and is produced by an ingenious process and is ultimately converted into a sugar solution which is evaporated and crystallized. Convertors hold 2200 gallons of starch solution which is changed into dextrose sugar by means of conversion with acid. Steam pressure is also needed to bring about this change. In our illustration will be seen the triple effect vacuum evaporators which are instrumental in changing the processed dextrose or corn sugar solutions into heavy viscous syrup which is marketed as corn syrup.



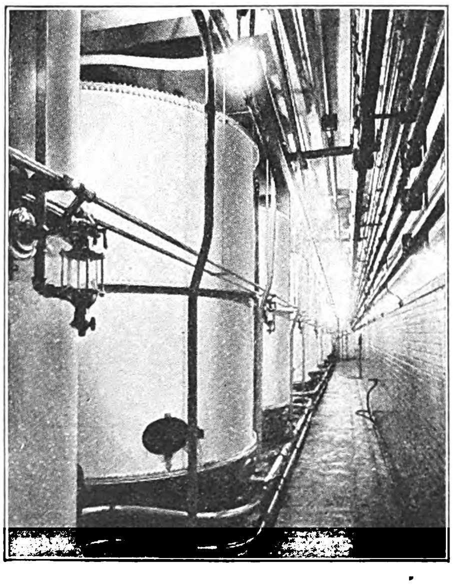
CONVEYING CORN SUGAR

The starch is converted into sugar solution which is filtered and evaporated in large vacuum evaporating pans; the resulting syrup when cooled is then crystallized, forming the corn sugar

The step toward the manufacture of yeast for baking is only logical. Its propagation for brewing purposes had been practiced successfully in the plant for over 70 years, but commercializing this product was not seriously thought of until after the prohibition law went into effect.

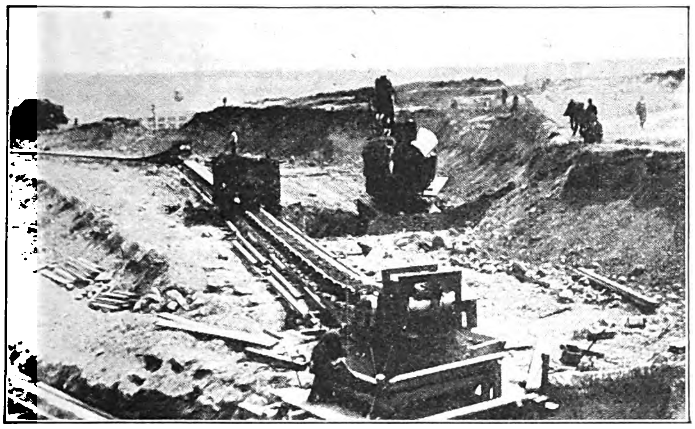
Yeast is virtually a plant which multiplies itself by means of "budding." Its growth and multiplication is accomplished in large fermenting tanks supplied with air. A nutrient solution is placed in the tanks. A small amount of seed yeast is introduced and is held in suspension by the air. It multiplies by feeding on the nourishing food present. After twelve hours the original seed yeast has multiplied itself approximately twelve times. It is separated from the spent liquid and pressed into forms.

The writer is indebted to Mr. Staudinger and Mr. Steideman for courtesies during a recent visit to St. Louis, and for technical information regarding the ancient art of brewing.



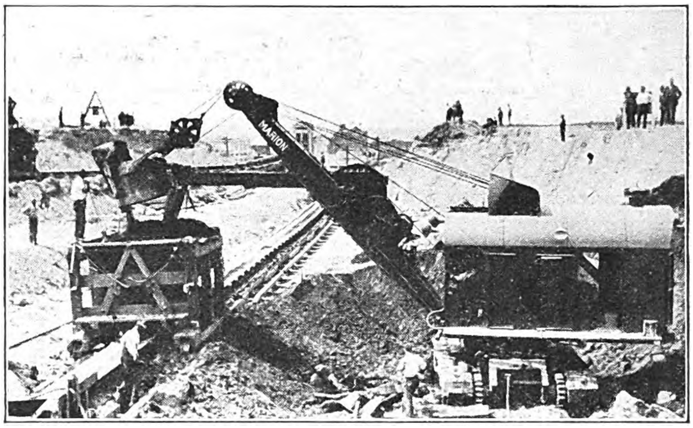
STORING "SOFT" DRINKS ➤

Here we show a battery of storage tanks for finished soft drinks before bottling



GENERAL VIEW OF THE PROJECT

Removing a hill in the heart of a city, noiselessly and efficiently, is no simple job. Here is shown part of the machinery used in Seattle



THE PORTABLE HOPPERS

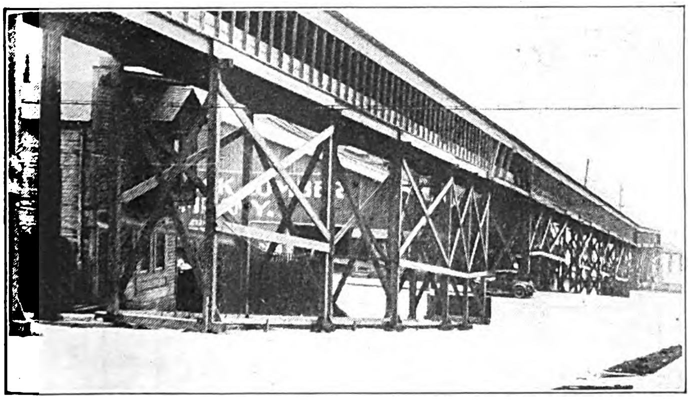
Hoppers like the one in foreground straddle the belt conveyors to receive the earth that is scooped up by electric shovels on the job

Unique Regrade Engineering

DECLARED to be the largest local improvement project of its type ever undertaken by a city, work has begun at Seattle, Washington, on the second Denny Hill regrade. This project involves the removal of 4,500,000 cubic yards of earth from the central portion of the downtown area and the distribution of this debris in the deep waters of Puget Sound by a unique system of conveyors which operate above the business district without interfering with street traffic. An outstanding feature is the fact that the whole operation is silent from the point where the dirt is excavated by huge electric shovels to the point where it is dumped upon novel "turn-over" barges which carry it to the dumping area. The cushioned, electrically-driven conveyor belts pass within a few yards of hotels and business houses, but their operation is quiet and so effective is the screening that no dust can be detected. Yet over these belts, which operate at a speed of 400 feet a minute, there pass 600 cubic yards of dirt an hour.

A number of difficult engineering problems had to be solved in this undertaking. Among major obstacles was the location of the project. The use of motor trucks was not practicable, nor could hydraulics be utilized. The only apparent solution was overhead conveyors. The preliminary work of establishing the system required six months, and about 400 working days will be necessary to complete the regrade job.

The conveyors are of two general types: portable and fixed. The fixed conveyors carry the debris across the business section of the city and dump it on scows for removal to deep water. These conveyors are made up of three sections, the first 950 feet long, the second 1500 feet in length, and the third 400 feet long. The several sections of this conveyor are on different levels, and each dumps into a chute which loads the next belt. The longest span, 1500 feet, requires very little power for operation as it is set on a down-grade and the weight of the load propels the belt.

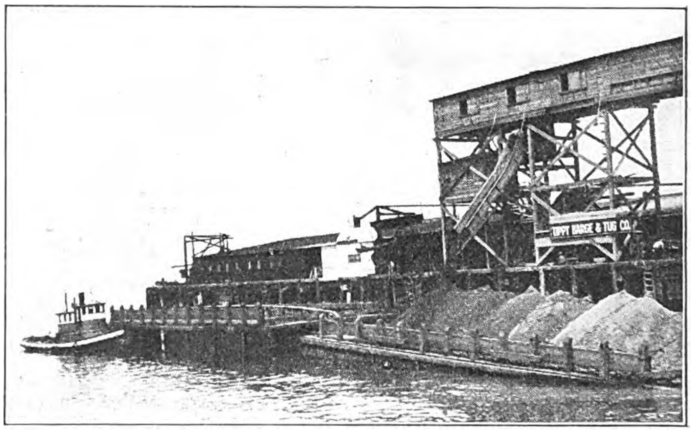


NOISELESSLY THROUGH CITY STREETS

High overhead, the belt conveyor carries many tons of earth to the accompaniment of a gentle swish as the belt passes over the rollers

The portable conveyor consists of six units, each 250 feet long. They carry dirt from the shovels to the fixed conveyor units. Straddling the portable conveyors are portable hoppers into which the shovels dump.

Specially built endless belts three feet wide, made of heavy fabric thickly coated with rubber, are used in both the portable and fixed conveyors. They are electrically driven and run over sets of rollers that mold them into cupped form to prevent spillage. The trestles are boxed in to prevent dust from sifting down on pedestrians or vehicles in the streets below.



INTO THE BARGES AND OUT TO SEA

At the end of the conveyor system, the earth is dumped into hoppers from which it goes down a chute to "turn-over" barges

The barges which carry the debris out into Puget Sound are of unusual design. They are scows with neither top nor bottom—one side carrying a load as efficiently as the other. They are built of timbers and contain water tanks to facilitate dumping. When a loaded barge has been towed to a spot in deep water where the cargo is to be dumped, sea cocks are opened, the tanks fill, and the barge capsizes. Relieved of dirt, the barge, now bottomside up, rides high, the tanks drain during the return to shore, and the side which was underneath becomes the deck for the next load. Top and bottom of the barge are alike.

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Device to Prevent Frozen Water Pipes

A SIMPLE device, to be connected directly in a residence water supply system and which prevents freezing and bursting of pipes, has been invented by a South Carolinian.

This device follows the thermometer and shuts off the household water supply when there is a threat of frozen and burst pipes. The principle is entirely new, and does not depend upon a thermostat or other mechanical device. Operations of the cut-off is automatic under natural laws. Returning warmth turns the water on again.

To accomplish this automatic operation, the device has a brass freezing chamber which spreads the water into a thin sheet easily frozen. The internal cavity of this chamber carries the exact volume of water that passes through the pipes. The flattened stream freezes at a temperature about 10 degrees higher than that which would freeze the water in the pipes themselves. Within the chamber, the ice takes the form of a wedge at inlet and outlet points. In freezing, the sheet of ice chokes the chamber and prevents the flow of water. The expanded ice exerts pressure against a metal diaphragm which opens a drain valve and empties the house pipes of all water. When the house becomes warmed, the thin sheet of ice thaws quickly and the thawing releases the pressure, closes the drain valve, and restores normal flow in the system.

Self-Locking Bolt and Nut Thread

A NEW principle in mechanics has been developed in a self-locking screw thread devised by Hugues Louis Dardelet, a French mathematical genius. Dardelet's effort to provide a locking device for bolts and nuts abandoned the beaten path followed by inventive genius for generations, and solved the problem without auxiliary mechanisms such as lock washers and cotter pins. His solution lies in the modification of the screw-thread itself.

Dardelet treats the screw-threads on bolt and nut as two inclined planes or wedges lying one on the other. He shows that, with the usual form of thread, vibration makes one wedge slide upon its neighbor, causing the nut to work loose. To prevent this sliding he introduces a second pair of wedges at right angles to the first pair. This profile presents a new locking principle which causes the thread to lock itself automatically, and causes vibration to tighten it rather than shake it loose.

The bottom of the groove A on the bolt, figure I, and the point of the thread B in the nut, figure II, are slightly tapered, rising outward at a 5-degree angle towards the point of the bolt. These are the locking surfaces. The groove is somewhat wider than the ridge.

The simple device which drains water pipes during freezing weather

When the nut is applied to the bolt, it fits loosely, as shown in Figure III. When the nut is screwed down and contacts with an opposed surface, the relative positions change, as in figure IV. The tapered surfaces A and B have now become wedged together with a force equal to the elasticity of the metal.

In this position the nut has become securely locked to the bolt, as a result of thread action alone. Since the locking principle lies within the thread, the lock operates at any point, wherever wrench tightening is discontinued. After being locked, the nut may be easily removed with the ordinary wrench, or may be screwed down to any extent for further tightening. The lock operates without injury to the threads and the nut and bolt may be used repeatedly.

Westinghouse Develops New Metal

DEVELOPMENT of a new metal known as Konel, which is credited with being much stronger than other metals at high temperatures and which can be used extensively in the moving parts of internal combustion engines and other extremely hot places, has been announced by officials of the Westinghouse Electric and Manufacturing Company. The announcement followed the granting of foreign patent rights.

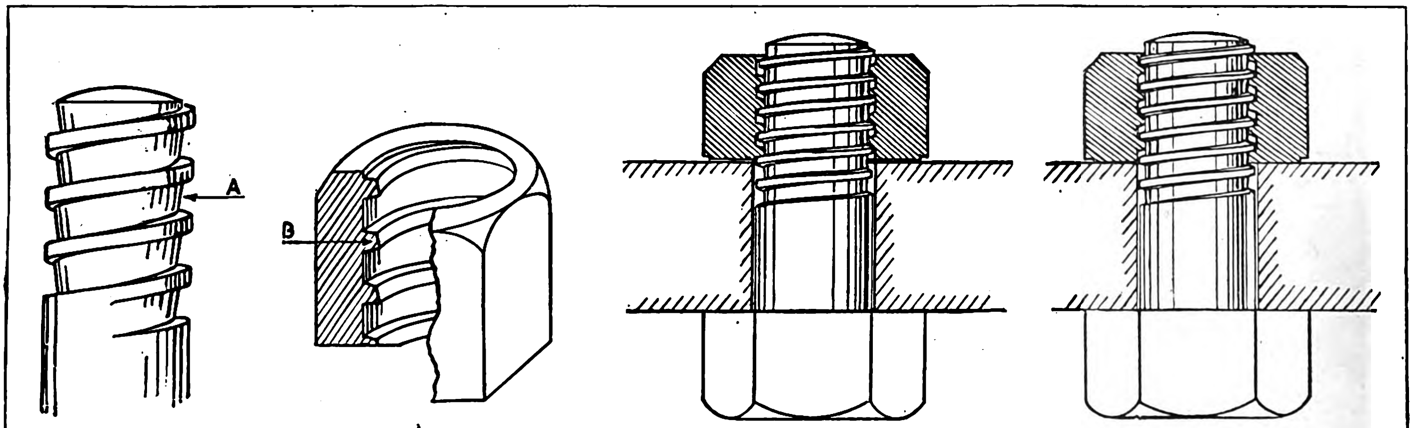
Originally developed by the Westinghouse Research Laboratories as a substitute for platinum in the manufacture of filaments for radio tubes, the new metal was discovered to be harder to forge than steel, and to be very tough at high temperatures, when most metals lose their strength. Engineers predict many uses for Konel. The new metal was created by Dr. E. F. Lowry, a graduate of Ohio State University.

Dr. Lowry said Konel had been subjected to exhaustive tests which revealed in turn the many valuable qualities it possessed.

"Almost without exception metals grow softer and lose tensile strength as they undergo high heat," he said. "We have found that Konel, heated to 600 degrees, Centigrade, which is approximately 1100 degrees, Fahrenheit, will withstand a pressure of 60,000 pounds to the square inch. Even further tests show Konel is tougher and harder when heated to 1800 degrees, Fahrenheit."

Dr. Lowry explained that Konel is a combination of cobalt and nickel from which it derives its name, and ferrotitanium.

As a substitute of platinum, Westinghouse officials are authority for the statement that Konel already is saving approximately 250,000 dollars monthly in the manufacture of radio tubes. Platinum costs



FIG·I FIG·II FIG·III FIG·IV

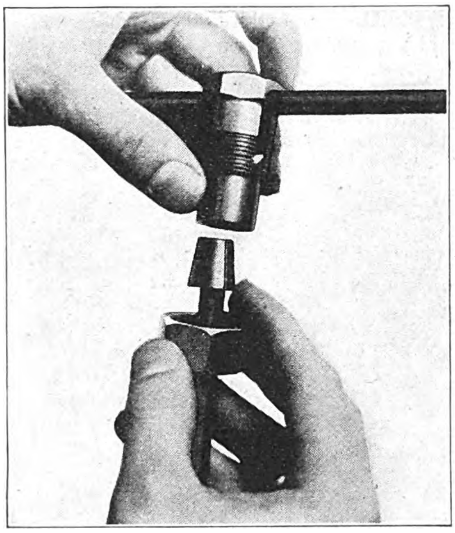
The self-locking thread for bolts and nuts as described in the article in the accompanying columns approximately 180 dollars per ounce, while the new substance costs only a few dollars a pound. Life of Konel filaments is approximately 10 times longer than that of other filaments. Tubes with filaments made of the new metal are operated 175 degrees colder than tubes with platinum filaments but with the same emission, thereby giving better reception results, research engineers say.

Solderless Wire Connector

A SOLDERLESS connector with a locking action that holds it tight permanently, is being manufactured by the Penn-Union Electric Corporation of Erie, Pennsylvania, for use on high tension lines. It consists of only four parts: the yoke, body, split sleeve, and nut.

When the lock-nut is turned onto the yoke, a split wedge-shaped sleeve forces the body of the connector up tight against the main conductor. At the same time the sleeve clamps tighter to the branch, equalizing the pressure on the main and branch conductors.

This connector tightens to the main and branch conductors simultaneously, in one operation, with the clamping pressure always equalizing itself between the two conductors.



A splice being made with the wire connector described here. It consists of four simple parts as shown

Weighing Moisture of Lumber in Kilns

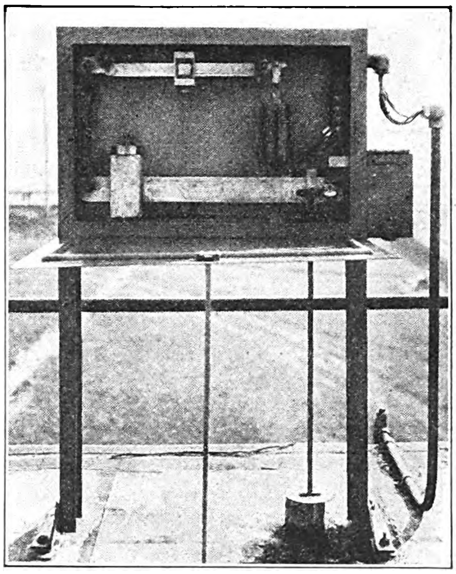
YESTERDAY'S housewife, when baking a cake, plucked a straw from the broom in the kitchen corner, poked it thru the crust of the cake, and removed the straw. If there was dough adhering to it the cake went back into the oven. Lumbermen, also, in the early 90's were satisfied with yesterday's methods.

Half-way between a modern sawmill and its shipping department is the heart of the lumberman's business. The success or non-success of his business often depends on the efficiency of his dry kilns. No inspector, however expert, is able to grade quality into lumber that has been abused in its seasoning.

Temperature, circulation, and humidity have been brought well within control, and the dry-kiln operator is in a position to conclude with reasonable accuracy the condition of his operation so far as these factors are concerned.

He charges the kiln, closes the doors, and is to a great extent compelled to trust to luck as to what is to happen to a kiln full of clears for the next 48 hours or so. The only method he has for getting an inkling as to what is going on inside the kiln is to open the kiln doors several times during the course of the charge, thus periodically upsetting all the temperature, circulation, and humidity conditions he has carefully built up.

T. E. Heppenstall of Longview, Washington, became interested in improved kiln drying practices. Working on the established fact that change of weight from time to time, as the seasoning progresses, is indicative of the moisture content of the stock, he set to work to design a machine to weigh lumber in the kilns while seasoning. The Heppenstall Electric Scale which he developed has been subjected to test after test for over two years and has been brought to such a state of perfection that it is now a reliable piece of dry kiln equipment. The device consists of a scale mounted on the roof of the kiln with a hanger suspended from this scale thru the roof to the interior. One or more full length boards are placed in this hanger, the green weights of these having been predetermined. As the drying progresses and the boards lose weight, the change will be indicated on a meter in the dry kiln operator's office or at any other convenient point. The meter shows exact moisture content percent without any calculation whatever. The scale is electrically controlled and automatic in its action. The weight suspended from the scale is registered on the dial by turning the controller handle until the indicating lamps signify a true balance.



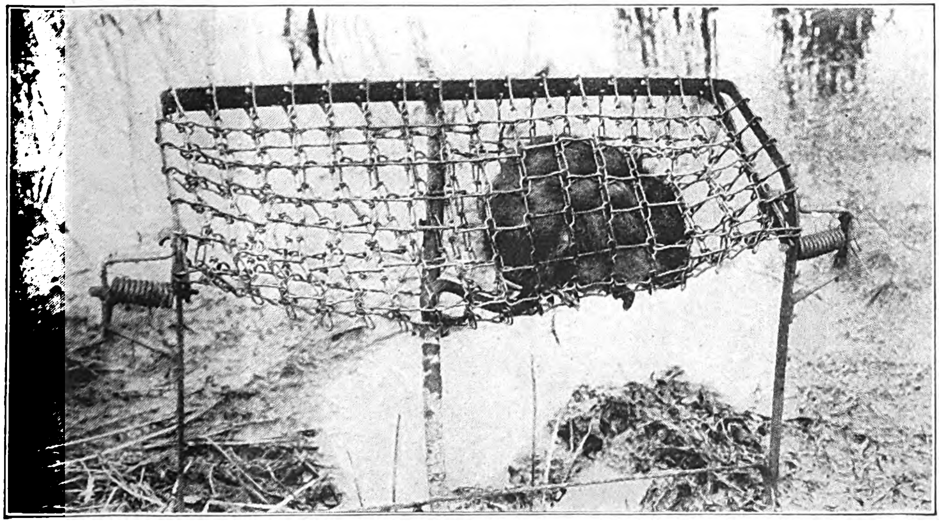
Weighing moisture content of lumber in a kiln. The rod at right projects through roof of kiln

Trap Which Catches Animals Alive

A TRAP which is a distinct departure from anything ever before considered, and which gives a positive answer to the clamor regarding the inhumanity of animal traps, has been developed by W. A. Gibbs and Son, Chester, Pennsylvania. It takes animals alive.

It is composed of a pair of jaws which are operated by coil springs. To these jaws is connected a net bag made of chain wire. A treadle is so arranged that the net bag lies over it when the trap is set and a guard is extended out under the treadle to prevent interference with its operation due to any obstruction. The treadle works in conjunction with a latch exactly as on any ordinary steel trap. When the latch is sprung, the jaws close and catch the animal in the basket-like wire net.

For trapping water animals such as mink and muskrats which would drown or die from exposure if left in the water after being caught, the trap is fitted with a lifting mechanism which raises the animal out of the water after it is caught in the net. These traps are now made with a lift of 15 inches.

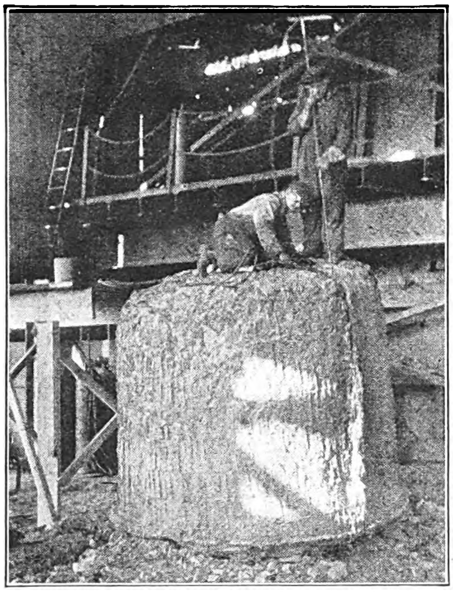


A new, humane animal trap made of chain wire fitted to jaws to form a basket-like holder. When the trap is sprung, the animal is caught alive

Cutting Heavy Material With the Oxygen Lance

PRACTICALLY everyone is familiar with oxy-acetylene cutting. The cutting blowpipe is extensively employed wherever commercial iron is used, and today the novelty of a workman cutting steel plate excites but passing interest.

It is not generally realized, however, that the oxy-acetylene process can be used to cut iron and steel of almost unlimited thickness. Cutting large masses used to be a problem about many plants. At steel mills, breaking up salamanders and removal of furnace spills were long, expensive operations. The difficulty of scrapping heavy, obsolete equipment was experienced in a great variety of industries.



A solidified ladle of steel being cut by means of the oxygen lance

The accompanying illustration shows a ladle of solidified steel eight feet high and weighing 65 tons, being cut to handling size. A delay in pouring brought about by a breakdown of the crane mechanism caused this molten mass to solidify in the ladle. Its reclamation presented a real problem to the management until they were assured that it could be handled by the oxy-acetylene process.

The first step was to break away the ladle and its refractory lining so as to expose the solid mass of steel. While this was being done an oxygen lance was rigged up. This is a simple device. It consists essentially of a length of one eighth of an inch or one fourth of an inch of steel pipe connected in suitable manner to a source of oxygen. For heavy work, several cylinders of oxygen are connected together by means of a manifold. Pressure is controlled by a regulator on the manifold and a length of oxygen hose leads from the regulator to the steel pipe that forms the lance.

The oxy-acetylene cutting blowpipe was used to start the cut at one side. The oxygen lance was then brought into play to carry the cut down to the bottom of the eight foot mass. Meanwhile the blowpipe was moved along the line of the cut on the top surface. The lance was then raised to pick up the blowpipe cut and again carry it to the bottom. This sequence of operations was continued until the cut was completed. The two pieces thus obtained were then cut into smaller pieces of such size that they could be placed in the furnace and remelted.

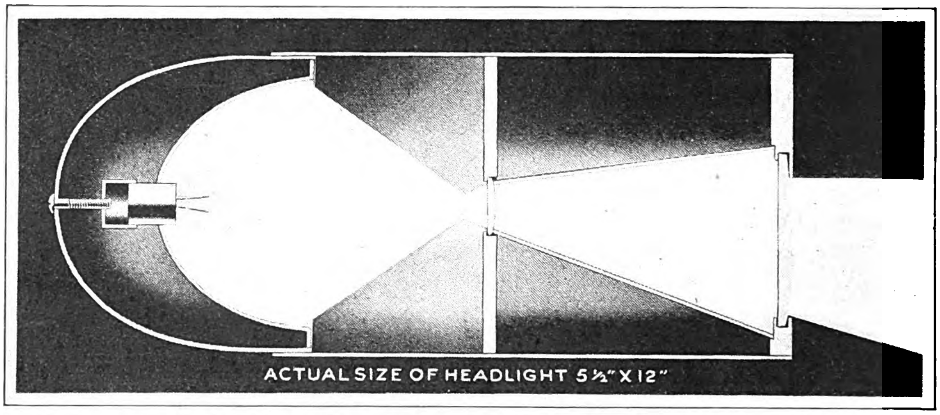
Highway Safety Illumination

CORRECT illumination of the highways to meet the demands of modern traffic with safety has been a difficult one. The faults and shortcomings of the open-face type headlight are caused by the inability to manufacture a 100 percent efficient reflector. Twenty percent or more of the light energy striking the surface of the headlight reflector is absorbed and produces a bright diffusing object in the line of vision of the approaching driver, regardless of the angle observed; therefore, this bright diffusing factor is predominant in producing a blinding effect upon the highway. It further creates a dual and antagonistic action when one or more cars approach each other from opposite directions along the highway.

In the development of a new headlight for automobiles, called the Invisolite, this dual and antagonistic action was the basis of research. It was evident that any bright object in the line of vision upon a dark highway would make the illumination of the approaching headlight unavailable and the vision of the driver imperfect.

The cross section illustration of the Invisolite gives in detail the construction and operation. By using a small reflector of the ellipsoidal type, the reflected or specular rays of light are converged to a focal point upon the optical axis adjacent to, and in front of, the primary reflector. From this point the light rays are re-projected and controlled through a lens into a secondary or co-operative conic reflector that uniformly distributes the light beams upon the roadway. The lower section of the conic reflector is so constructed that the re-projected light rays do not contact therewith but illuminate its white matt surface, making the headlight visible when approaching.

The section above the optical axis is so constructed that 60 degrees of its top surface reflects the re-projected rays within and contiguous to the direct and long beam of light projected upon the roadway. The 120 degrees, or remainder, of the conic reflector above the optical axis are so aligned with the rays controlled by the focal control lens that the reflected beam therefrom augments the foreground illumination and produces the unique side beams. The small focal control lens is concentric with the optical axis, and the frontal spread control lens is eccentric therewith; therefore, the eccentric relation of the front lens to the optical axis prevents a reinversion of the light beam beyond the reduced frontal-emitting aperture of headlight, and prevents a dark spot being formed upon the roadway.



An automobile headlight designed to give proper illumination on the highway without producing a diffused glare. Telescope-like lenses do the trick

New Soviet Gun Fires 150 Shots a Minute

UNDER a Moscow dateline, Walter Duranty, writing in the *New York Times*, says, "The Red Army is now being equipped with what is declared to be the world's best light machine gun. It is said to be greatly superior to the Lewis gun in mobility and rapidity of fire.

"The gun was invented by a Russian named Degtaryef and is wholly produced in Soviet factories. It weighs eight kilos, (17.632 pounds) compared with the Lewis which is fourteen kilos, (30.816 pounds). It can fire at a rate of 150 shots a minute. The Lewis can fire 125 a minute.

"The cartridges are of the same caliber as is used in the Russian service rifle. The gun is sighted up to 1300 meters, (4265 feet) but it is effective for use from 600 to 800 meters.

"The new weapon is being installed in Soviet war planes which previously were equipped with Lewis guns."

Portable Heat For Maintenance and Repair

PUBLIC utility corporations, whether they furnish gas, electricity, or telephones to vast communities, are all striving to give the best service they possibly can. Most people realize this fact and when a severe storm or other unusual circumstance disrupts this service they are always willing to bear with the utility company until the trouble can be located and repaired. A hundred and one things may happen during a storm to disrupt the service. The damage is quickly located and repaired with modern tools and repair equipment which would make the old time "trouble shooter" stare in amazement.

For example, a majority of the telephone companies have equipped their repair and maintenance crews with compact outfits, consisting of a small Prest-O-Lite tank containing 10 cubic feet of acetylene, a length of hose, a torch with various attachments, and a lighter. With these outfits, all kinds of soldering, splicing, wiping, and similar operations on wire, cables, or switchboards

All kinds of repair operations on wire may be carried out with ease with this new portable gas torch are easily accomplished. Similar outfits are also widely used by garages, battery repair stations, and for general shop work in industrial plants.

There are several features which recommend these outfits: They get into action immediately. No preheating is necessary. Simply turn on the gas, light the torch, and the job is under way. They are economical and operate unfailingly in all kinds of weather. When the flame is not in actual use it can be turned off and relit instantly when needed again.

Amende Honorable

WE have been guilty of a grave lapse in etiquette and so take this means of making amends.

In the "Lively Baseball" article which appeared in our October issue we illustrated a piece of moving picture film showing the flight of the baseballs, taken at the Polo Grounds by Fox News, through the courtesy of Mr. James E. Darst, who undertook considerable expense and time to take these films.

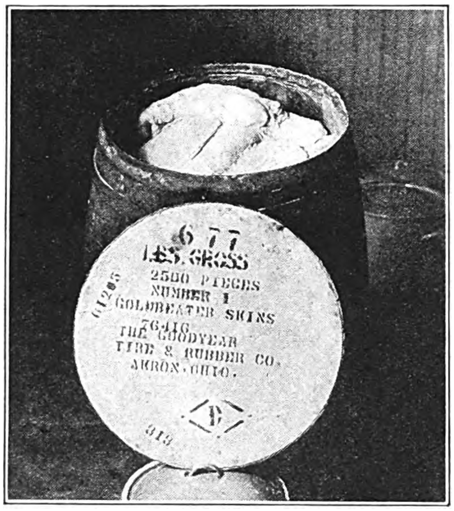
The unprecedented rush in which the article in question was prepared for publication resulted in an entire omission of any reference to Fox News.

We wish herewith to record our thanks for their generous co-operation, together with our sincere apology for the fact that this was not made in connection with the article.

The Value of Neon Light in Penetrating Fog

SINCE the installation of the neon tower at Croydon Airport, London, early in 1924, neon light has been championed by many as the panacea for all difficulties due to flying in fog. On the other hand there are those who claim that neon light has no added value over ordinary lights for fog penetration. More or less elaborate tests, made by the Bureau of Standards, the Illuminating Engineering Society, and others, seem to agree on certain points.

The fact that red light penetrates fog and mist more easily than white light is an admitted scientific fact, although some scientsts will explain the result by saying that the candlepower of penetration is the same but that the eye is more sensitive to the red rays and can see a much smaller candlepower of red light than it can of white light. By any explanation, the result is the same.



Raw goldbeater skins to make the gas cells of airships arrive at the plant packed in barrels of salt

This is apparent to anyone who has admired the orange-red appearance of the setting sun on the western horizon. The color of the light that emanates from the sun is the same at the source at all hours of the day but as it sinks lower in the sky and the rays must pass through the mist and clouds that hover about the earth, only the red light rays of the sun are visible.

The question then arises as to what is the most effective way to produce a red aviation beacon to secure the utmost penetration of fog. It is possible, of course, to use the ordinary electric lamp with a red screen, but based on the wattage necessary per candle-power, it is not practical when compared with neon light, which is more economical. The use of a colored screen cuts down the candle-power of the lamp, as from $^1/_3$ to $^5/_6$ of the original light is absorbed by the filter and wasted.

Electrified neon gas gives forth a natural orange-red glow at the cost of only ½ watt for each horizontal candlepower; in fact along the German air routes it is reported that neon course lights have been allowed to operate 24 hours a day because of their economy of electric current.

The fact remains that those airdromes that have installed fog-penetrating beacons with any degree of success have utilized neon tubes. The neon tower at Croydon has become famous. One pilot flying over France 100 miles away reported having seen it.

The neon beacon has another advantage in that its light is a peculiar shade of orange-red which is easily distinguished from other lights. Also, it has good visibility in clear weather.

Sand Bags for Blasting

BLASTING in connection with construction work in the large cities is greatly facilitated by the use of what are known as tamping bags. These are paper shells made in practically the same diameter as dynamite cartridges and are filled with sand. They are loaded in the bore hole on top of the dynamite charge and are particularly advantageous when loading upper holes, keeping the tamping intact. Another reason for the tamping bags is that they expedite the loading of holes. The more actual weight there is on top of the dynamite charges with the holes properly confined, the better the results.

After goldbeater skins are prepared, they are cut into sections and applied to rubberized cloth

Goldbeater Skins for Airships

FOR retaining the precious hydrogen or helium lifting gas in Zeppelin airships, nothing has been found superior to goldbeater skin. This extremely tough substance forms the outer covering of a portion of a steer's intestinal system. For centuries it has been used for holding gold sheets while they were being hammered into thin foil. Hence the name.

The skins are shipped in their raw state from the packing house to the airship cell manufacturer in barrels, each containing about 2500 pieces. After skins arrive at the factory, they are scraped with knives until all particles of adhering flesh and other matter are removed. This cleaning takes place after the skins have been softened by soaking in water They are then

(*Please turn to page* 451)

The first operation in preparing goldbeater skins is to scrape them

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

Handley Page Slot Mechanisms

WE have often discussed in these columns the famous Handley Page slot which smooths out the flow on the upper surface of the wing when it is at too large an angle to the wind, and thereby increases the lift and prevents stalling.

The aerodynamic effectiveness of the slot has long been demonstrated. The next question is the mechanical design of the slot mechanism so that it may function on a full-size machine as well as it does in wind-tunnel experiments.

Lieutenant Carl Harper, in a valuable paper presented before the Society of Automotive Engineers, deals with airplane spins and slots and describes a number of effective mechanisms. These are illustrated in the appended diagrams.

The first is a parallel link type. When the slot is closed there is a small vent at the top rear portion of the auxiliary airfoil. This type of slot gives a progressive, somewhat slow operation.

The second or gate type also has a vent at the top of the auxiliary airfoil, but nevertheless gives quick opening and closing of the slot.

The third is a straight-roller type, which also gives quick opening and closing.

It may be asked why it is that the slot functions automatically. This is because, at high angles of lift, the suction on the upper surface of the wing tends to concentrate itself at the leading edge, and the movement of the suction forward opens the slot up by the pull of the air on the small auxiliary airfoil.

It has been found that the lift-increasing properties of the Handley Page slot can be greatly improved when it is used with a flap at the rear of the wing, which turns down when the slot is opened. For heavily loaded machines, which would otherwise have a high landing speed, it is a great advantage to have a front slot working in conjunction with a rear flap.

For certain reasons it may be preferable, where lift increase is the objective, to have the front slot and rear flap interconnected and manually operated. The mechanism used in such a case is shown in the fourth diagram. It will be seen from this diagram that the parallel link mechanism now operates jointly with the aileron moving mechanism by means of the long rod hinged at either end. When the flap is lowered, the slot is opened. Of course, in such mechanism the flap cannot be raised, so that this particular mechanism is not suitable for the slotted type of aileron, that is, an aileron which has a slot ahead of it.

A vent at the top of the slot, when closed, delays its opening. A vent at the bottom hastens its opening. Hence in the design and construction of a slot, the fit must be perfect. A slot must be a hand-tailored fit for a particular wing. Both slots must lift an equal amount. Both slots must open at low air-speed, and furthermore, both slots must open at the same air-speed.

Since spinning is closely connected with the stall of a wing, the slot is a powerful preventive against spinning. With a fast navy plane, the Vought Corsair, Lieutenant Harper put his machine into a fast spin and unlocked the slots. The slots opened automatically and brought the plane out of the spin in half a turn.

Ice formation, so dangerous in flying, does not seem to impede the action of a slot. A plane was flown at 10,000 feet and ice had formed to such an extent that it almost doubled the width of the exposed streamline wires. Nevertheless the slot continued to function perfectly.

On the other hand, slots themselves introduced an element of danger. If one slot has a little more friction than the other, its opening will be considerably delayed. Under such circumstances one slot may open in a spin and the other remain closed. Instead of stopping the spin, the slots may then tighten it to a dangerous extent.

We believe that the increasing interest and experimentation with the slot will soon remove the mechanical difficulties still remaining.

Certification of Private Lights

THE owners of many hotels and large apartment houses are showing their public spirit by installing private lights as aids to aerial navigation. Such lights may be certified by the Department of Commerce. For example, the Wardman Park Hotel in Washington, D. C., is operating a 36-inch beacon of 10,000,000 candlepower, rotating at two revolutions per minute on the roof of its building. In conjunction with this light there is a directional projector of 8,000,000 candlepower pointing southeast to Bolling Field, one of Washington's best known fields.

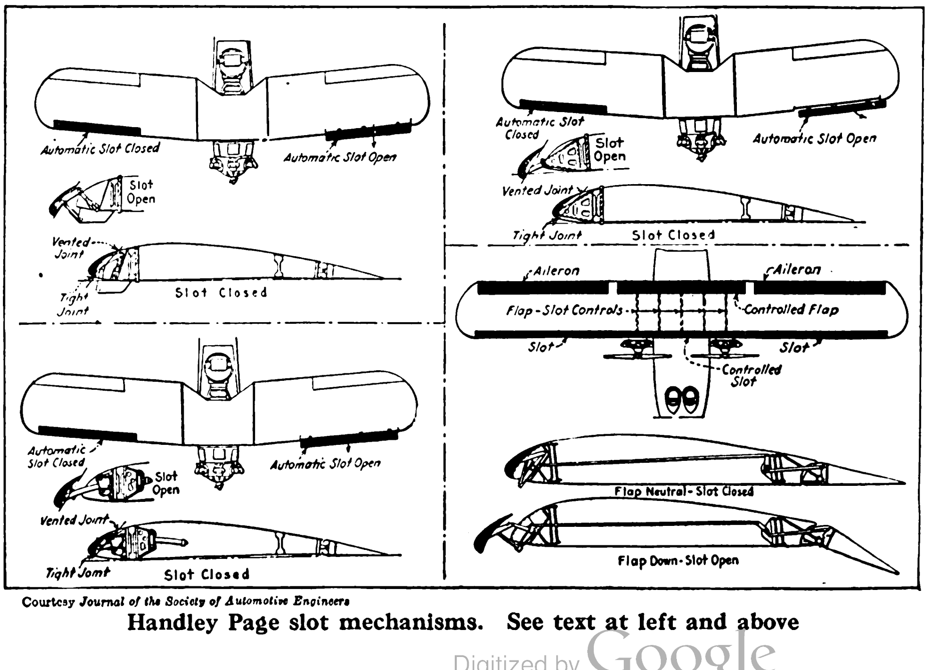
A Successful Metal-Clad Airship

THE metal-clad airship built by the Aircraft Development Corporation of Detroit has recently made several successful flights, while Dr. Eckener in the *Graf Zeppelin* has completed his stupendous journey around the world. These two events have greatly encouraged, and rightly so, the supporters of the airship, and plans for transoceanic services by airship, particularly from San Francisco to Hawaii, are being actively discussed. At a recent dinner in New York City, considerable progress was made toward the formation of an airship line. Such interests were represented as the Goodyear-Zeppelin Corporation, the Zeppelin Corporation of Germany, the Dollar Steamship line, and the two great banking houses of Lehmann Brothers and G. M. P. Murphy and Co.

Arguing from the fact that all engine structures pass from such materials as wood to the engineering metals, many authorities are of the belief that airships will likewise in similar fashion pass from a fabric covering to a metal covering. Carl B. Frietsche, President of the Aircraft Development Corporation, recently made a splendid statement of this viewpoint.

Strange to say, the idea of a metal-covered airship is not at all new. In the latter part of the 19th Century, an Austrian named Schwarz actually built, in Berlin, a rigid airship covered with thin aluminum. It was 155 feet long, with a maximum diameter of 44 feet, and a displacement of about 130,000 cubic feet. In 1897 this somewhat crude airship was carried by the wind to a forced landing and was badly damaged.

For some time the idea of a metal-covered airship was dormant until, in 1921, Ralph H. Upson, a well-known airship designer, undertook the design of a metal-clad airship, with vastly improved techni-



Courtesy *Journal of the Society of Automotive Engineers*

Handley Page slot mechanisms. See text at left and above

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Cheap Aluminum Chloride Now Available

FIFTY years ago, the French chemist Friedel and his American associate Crafts began performing miracles of organic synthesis by the use of aluminum chloride. The reaction, since known by their names, has been a useful laboratory tool for the organic chemist ever since, but the accomplishments were limited to operations on a test-tube scale because of the prohibitive cost of aluminum chloride. The announcement of its successful manufacture by a process that puts aluminum chloride in a class with the cheapest heavy chemicals has been hailed by the American Institute of Chemical Engineers as a development of outstanding interest to the chemical industry.

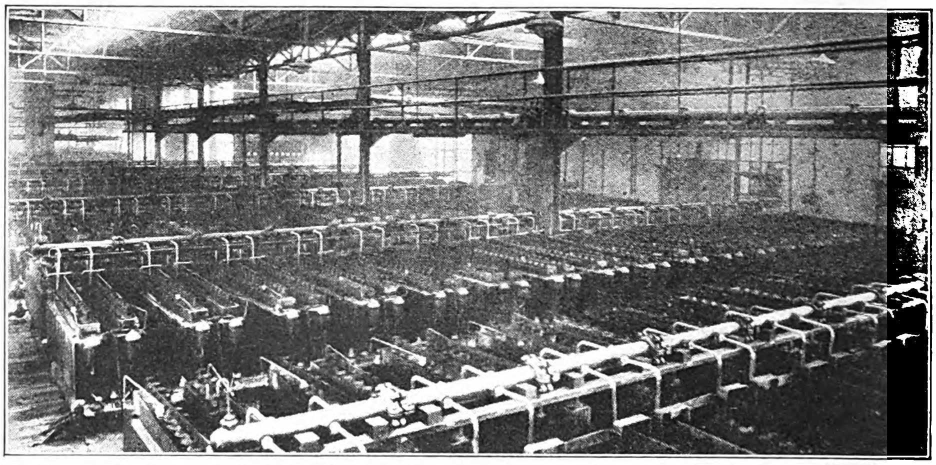
As *Chemical and Metallurgical Engineering* says editorially, "Dr. A. M. McAfee's modest recital of the 15 years spent in perfecting the commercial production of aluminum chloride is a classic story of patient, persistent chemical engineering development. His audience at the Philadelphia meeting of the American Institute of Chemical Engineers was quick to acclaim it as an outstanding achievement, although, obviously, it is still too soon to gage its full significance. In the oil industry, to be sure, the McAfee processes for producing gasoline from high-boiling petroleum oils and for refining lubricating oils at moderate temperatures have long demonstrated their worth in the Gulf refinery. The scale of operations there may be judged from court records showing that the company has spent approximately 4,600,000 dollars on the aluminum chloride division of its Port Arthur refinery. Two carloads of Arkansas bauxite and two carloads of Louisiana salt are said to be consumed each day in the aluminum chloride plant."

In the dye industry the potentialities of cheap aluminum chloride are enormous. It is no exaggeration to say that dozens of well established processes may be revolutionized by the ready availability of the useful reagent.

Said Dr. McAfee, "In 1913 I purchased a few pounds of aluminum chloride for $1.50 per pound. Six weeks were required to get it. Today the Gulf Refining Company is manufacturing it at Port Arthur, Texas, from bauxite ore and chlorine, at the rate of 75,000 pounds per day and at a cost that permits its sale in carload lots at five cents per pound."

Details of the present process, which has been operating successfully for several years, are as follows: Crude bauxite ore is calcined in an internally heated rotary kiln at about 1800 degrees, Fahrenheit, to drive off the moisture. From the kiln the bauxite is delivered by belt conveyor and bucket elevator to a weighing hopper, where is added a good coking coal in the proportion by weight of approximately three parts of bauxite to one part of coal. The mixture of bauxite and coal is then put through a pulverizer in which the two solids are ground to a powder. From here it is directed to overhead hoppers which feed into mixing vats to which is delivered a liquid binder, such as wax tailings or melted asphalt. The mixers discharge automatically into machines which press the bauxite, coal, and binder into briquets under a pressure of 3000 pounds per square inch. Each briquet weighs approximately two pounds. The briquets are preheated to approximately 1500 degrees, Fahrenheit, driving out the volatile matter in the coal. This leaves a hard briquet composed of approximately 82 percent bauxite and 18 percent carbon. The hot carbonized briquets are then charged to the chlorinating furnaces.

The largest of the furnaces has a capacity of 40,000 pounds of aluminum chloride per day. It has an inside diameter of five feet, and the shaft is 20 feet in height. A blast of air is introduced near the bottom and also halfway up the shaft for about 15 minutes, at the end of which time the charge of briquets will have been heated to the desired chlorinating temperature, approximately 1600 degrees, Fahrenheit. The door is then closed, and chlorine is admitted through inlets near the top. The chlorinating process requires from eight to ten hours. Through an outlet near the bottom of the furnace, the aluminum chloride passes to condensers.



Electrolytic cells in which chlorine is generated from salt for use in the manufacture of commercial aluminum chloride, used in the dye industry

Australian Motorists to Use Gasoline Mixed with Alcohol

A NEW company known as National Power Alcohol Company has been founded in Australia, with a capital of 250,000 pounds of which half is in the hands of the Distillers' Company and the other half in the hands of Australian interests. The product of the company is to be a new motor fuel composed partly of alcohol. A factory is being built at Mackay, North Queensland, and others will be built later at Townsville and Cairns. The alcohol will

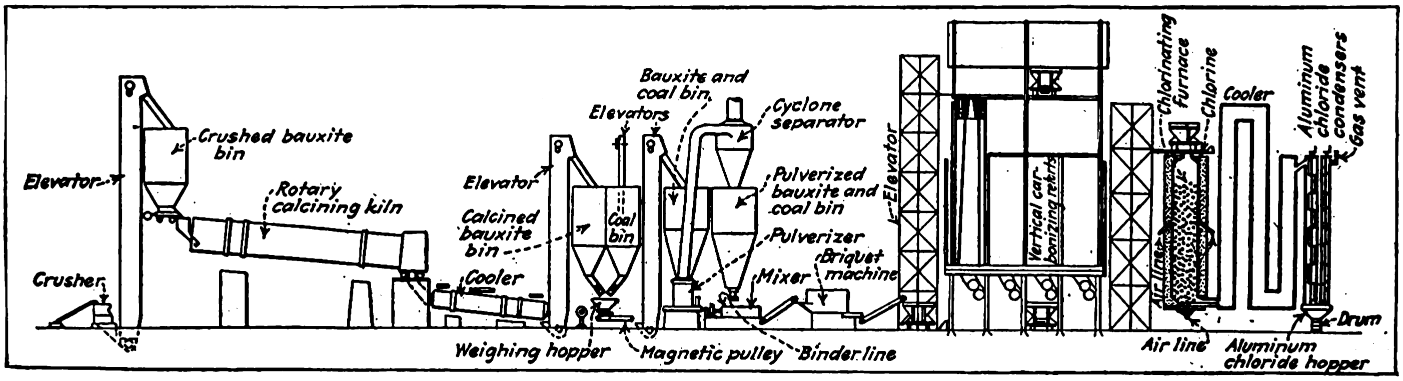
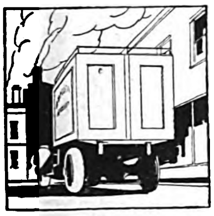


Diagram of equipment and steps in the process for making aluminum chloride

For trucks in the city, for tractors in the country ..this *grainless* wood board

This grainless wood board, Masonite Presdwood, has hundreds of uses in industry and building. It does not crack, split or splinter, is almost impervious to moisture and highly resistant to warping and buckling. Is naturally beautiful; takes any finish. Production costs often drop off sharply when Presdwood is used. Samples to try out will be gladly sent on request.



FOR MOTOR TRUCK PANELING

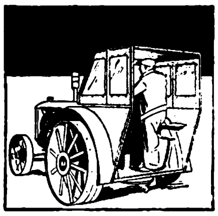
Seen by thousands every day, a modern motor truck in city service portrays on its paneled sides of Masonite Presdwood an attractive sign which advertises the truck owner's business. Out on some windswept farm the operator of a toiling tractor is perfectly protected from flying sand and driving rain by a cab which is made of this same grainless wood.

In one case Presdwood is used for its strength, smooth surface and ability to take any paint finish. In the other it is employed for its resistance to moisture and the sturdiness which enables it to withstand the hardest kind of usage.

Has Hundreds of Uses

These qualities of strength and beauty, as well as the workability of a grainless board that does not crack or split, have made Masonite Presdwood the chosen material for hundreds of manufactured articles. It is used for bedroom screens and radio cabinets, clothes hampers and bread boxes, breakfast nooks and kitchen cabinets.

Because of Presdwood's smoothness and strength it is ideal for work-bench tops, ice box paneling, cupboards and shelving. It makes core trays in foundries, starch trays in candy factories; is employed for its moisture resisting ability in the construction of campers' tables, speed boat hulls, highway markers and outdoor signs of all kinds. In fact there seems to be no limit to the many uses for this grainless wood.



FOR STURDY TRACTOR CABS

In the building industry, Presdwood is being used in ever increasing quantities. It panels fine homes and the more modern buildings, takes any commercial finish. In concrete construction, Presdwood is often used to line the forms, for it produces such a perfect smooth surface that the need of hand smoothing is practically eliminated.

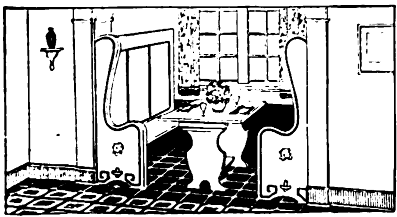
Liked by Mechanics Everywhere

Presdwood has made friends in factories because of its workability, for skilled artisans, familiar with every type of material, have been won over by the ease with which Presdwood can be punched, sawed, milled, or sanded. This grainless wood cuts production costs by eliminating the waste and costly rejections which result from defective material. Where handy men make things around the home, Presdwood is equally in demand, for anyone who uses tools instantly recognizes the possibilities of a grainless wood board that neither cracks, splits nor splinters.

Factory executives, builders and home owners should read the Presdwood booklet which tells how Presdwood is made, lists eighty of its many uses and gives instructions for applying many types of finishes. A copy of the booklet will be sent promptly on request.

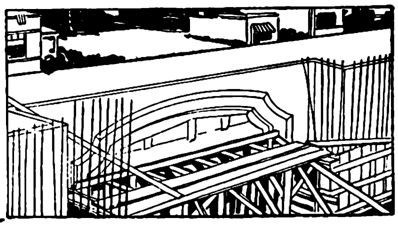
MASONITE CORPORATION
Dept. 743, 111 West Washington Street
Chicago, Illinois

FOR BREAKFAST NOOKS

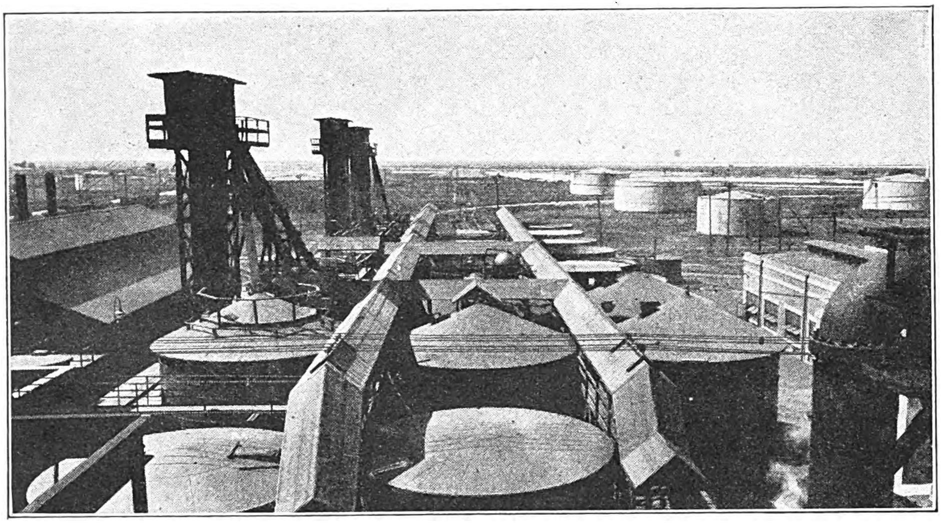


Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR LINING CONCRETE FORMS



© 1929 M. C.



Bins in which salt is stored, awaiting electrolytic treatment

be produced from molasses by fermentation and freed from water by a special process, in order that it may be readily mixed with gasoline, forming a mixture of 15 percent of alcohol and 85 percent of gasoline. This mixture will be put on the market as a motor fuel under the name "Shellkol," the necessary gasoline being supplied by the Shell Company, which will also take charge of the marketing.

Skyscrapers Rest on Lead Mattresses

WE ordinarily think of skyscrapers as built of steel and concrete, and not many people realize that occasionally considerable quantities of lead are used in their construction. Lead "mattresses" are used to act as shock absorbers between the foundations and the steel framework of skyscrapers. In one building in New York about 55 tons of lead appears to have been used for this purpose.

Another new use for lead is developing in the pigment field where a new lead preparation called "subox" has been introduced. This preparation, which consists of very finely divided particles of lead suboxide suspended in linseed oil, can be sprayed or applied with a brush upon any surface. After being applied it undergoes a slow transformation, resulting in a film of metallic lead held firmly as a protective coat by the oxidized oil.

Producers Censured for High Cost of Radium

CHARGING that greed for profits on the part of the producers of radium is withholding full benefit of radium treatment from cancer patients, *Industrial and Engineering Chemistry* presents a dramatic indictment on the editorial page of a recent issue.

"Universal agreement as to the efficacy of radium in therapeutics is not to be expected," says the writer, "but there is a considerable body of authoritative opinion to the effect that radium, when used skillfully and in sufficient quantity, still offers the best means known for the treatment of certain types of cancers, to mention but one important application relating to the maintenance of health and the defeat of disease. Where radium has failed authorities tell us the cause has more frequently been the insufficient quantity of the radium salts available than any other reason. These quantities have remained small because of the high cost, requiring too large an investment for most users.

"Among those prominently identified with the study and production of radium is R. B. Moore, now Dean of Science at Purdue University. We quote a recent letter from Doctor Moore:

" 'When radium was made from 2 percent ore it sold for about 110,000 dollars per gram of element. At the present time, made from 40 percent ore, it is selling in retail quantities for 70,000 dollars per gram. The wholesale price in large quantities purchased direct from the Belgian company is from 50,000 dollars to 60,000 dollars per gram.

" 'The actual costs of the company for producing radium are not known, but it should be very easy to obtain this rare element from 40 percent ore for about 10,000 dollars per gram, exclusive of mining costs and overhead.

" 'Meanwhile, thousands of cancer patients are dying every year who do not have an opportunity of being treated by radium which, at the present time, is the only successful treatment for cancer outside of an operation. A larger production and a much wider distribution would mean an additional number of lives saved.'

"While the belief that the Belgian Congo contains great quantities of ore from which radium can be extracted and that these deposits are now hidden in order to maintain high prices may be erroneous, nevertheless it is known that the one or two outside men who have been permitted to visit the mines did so only after making solemn promises to maintain secrecy. We are informed by one who visited the plant in the early days that the cost at that time was not over 5,000 dollars per gram of radium.

"The maufacturers and producers of a luxury may ask a price which returns an unreasonable profit and no one complains seriously, for we can dispense with luxuries. A hoarder of food who endeavors to extract a fabulous profit for a necessity would be given no mercy. What shall be said then of a company which, although numbering among its stockholders citizens of other lands, is nevertheless controlled by those identified with a country which sought and was given the help of the world, and which now demands the utmost the traffic will bear for a material which to many means the difference between life and death?"

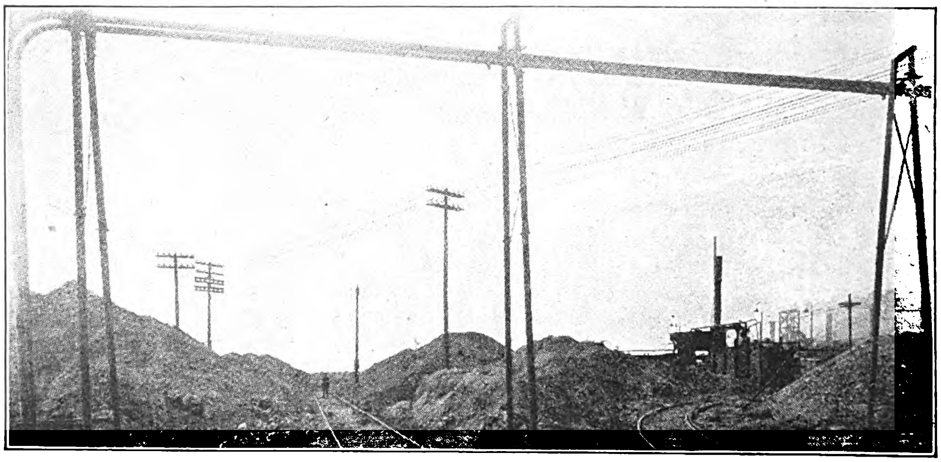
New Heat-Resistant Alloy

THE development of a ferro-chrome alloy that will repeatedly withstand working temperatures in excess of 2000 degrees, Fahrenheit, in contact with molten metal, was recently announced by Alexander Forward, managing director of the American Gas Association. Formerly, crucibles had a life of only about 15 or 20 heats, but a single retort made from the new alloy has already served for more than 250 heats and is apparently none the worse for wear.

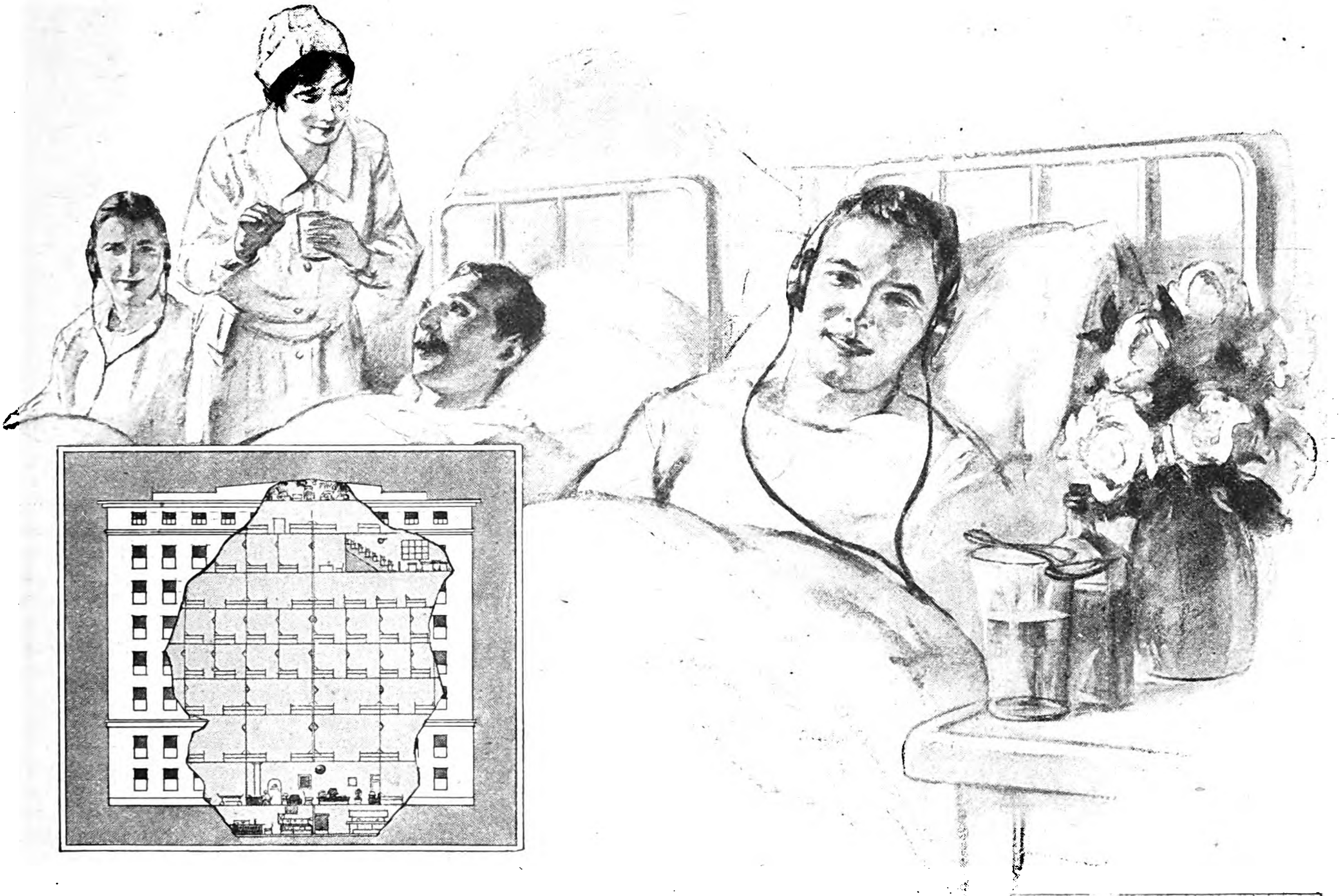
The research work in connection with this new ferro-chrome alloy is only partially completed and it is expected that another year will be required to develop an alloy that will meet all the requirements of the brass furnace. This investigation is being conducted by the American Gas Association in collaboration with the American Gas Furnace Company, of Elizabeth, New Jersey.

German Chemist Tames Nitroglycerine

NITROGLYCERINE is notoriously "skittish" and because of its tendency to "fly off the handle" on the slightest provocation, its use has been limited in many fields. Up to now, nitroglycerine preparations have been prohibited for military uses because of their great sensitivity, but Dr. A. Stettbacher of Zurich, has succeeded in making a mixture of 20 percent nitroglycerine and 80 percent pentaerythritetetranitrate which may remove this difficulty. The compound is called Penthrinit and has extraordinary explosive powers, besides its stability to shock. Its coming popularity is further promised by the relative economy of production by standard electrochemical means.



Piles of bauxite ore, from which is derived aluminum chloride



Healing by Music

Modern hospitals put the Western Electric Public Address System on staff

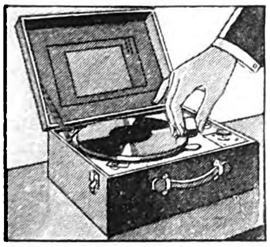
Music hath charms—and healing powers. Lucky is the hospital patient whose convalescence is cheered and hastened by entertainment through the Western Electric Public Address System.

It amplifies and distributes sound to all parts of the hospital by means of loud speakers in private rooms and telephone headsets in wards. And patients can listen to radio broadcast, or entertainment put into a microphone in the building, or phonograph records played on the Western Electric Music Reproducer.

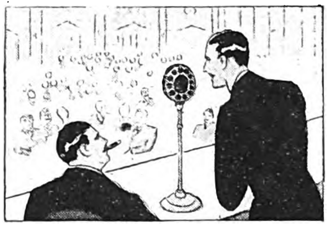
Here then is a soothing bedside visitor always on hand at the right moment.

The Western Electric System has many advantages which appeal to progressive hospital managements. Architects and engineers value it because it is electrically reliable, made by the makers of your telephone.

To hospitals, hotels, schools, amusement parks and communities, it offers new opportunities for service to their public.

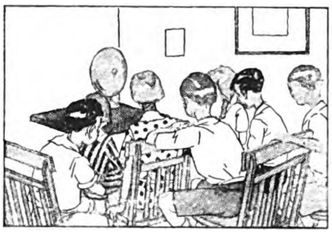


The Western Electric Music Reproducer, ever ready to provide entertainment from phonograph records.



Now all can hear in the hotels' large meeting rooms.

Dancing to the Music Reproducer at restaurant or country club.



The school principal can, by loud speaker, address all rooms at once.

Western Electric

PUBLIC ADDRESS AND MUSIC REPRODUCTION SYSTEMS

DISTRIBUTED BY *Graybar Electric Company* OFFICES IN 72 PRINCIPAL CITIES

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association *and of* Hygeia

Tobacco Smoking

DR. WINGATE M. JOHNSON of North Carolina, who does not himself smoke but who lives in a neighborhood where much tobacco is produced, called up 1000 men whose names were in the telephone book and had his friends in four other cities in that vicinity do the same thing to find out how many of the men smoked. Eight hundred and eighteen of them did. Out of 60 fatal cases with angina pectoris, 70 percent were found to be smokers, 30 percent were non-smokers. The average age at death of the smokers was 61.3 years and of the non-smokers 62.5 years. Thus 70 percent of people with angina pectoris were smokers and 81 percent of the male population were smokers.

There are some people in whom moderate smoking causes attacks of pain in the heart similar to those associated with angina pectoris. This, however, is not true disease.

Doctor Johnson looked particularly into the charge that tobacco smoking by women during pregnancy and by nursing mothers was injurious to their offspring. He cites the records of five women who smoked freely through pregnancy and afterwards nursed their babies successfully for many months.

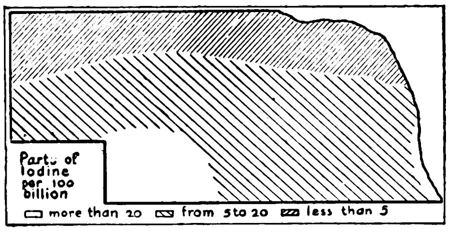
The blood pressure of 150 adult male smokers was 128.23 systolic and 78.87 diastolic. Among non-smokers, the average systolic pressure was 129.64, the diastolic 79.23. The non-smokers weighed about three pounds less on an average than the smokers.

Thus Doctor Johnson concludes that tobacco smoking has apparently no permanent effect on the blood pressure, that there is no foundation for the public belief that smoking decreases the weight, and it does not seem to be well established that smoking bears a definite relationship to angina pectoris. The chief bad effects produced by tobacco smoking, even in moderation, are irritations of the lining of the throat.

Iodine Surveys

THE value of small doses of iodine for the prevention of goiter has now been fully demonstrated. Through the combined efforts of investigators numbers of dissimilar diseases have been related to a deficiency of iodine in the food. The deficiency of iodine in the food is definitely related to the lack of iodine in the rocks and the soil from which the food comes. Simple goiter in man occurs in definite areas in relationship to the amount of iodine in the soil. Our eastern seacoast is comparatively free from the disease, while our Great Lakes region and the Northwest have much of it. While it is not certain as to just how the iodine acts to prevent the disease, it is generally believed that it has an influence on the thyroid gland and a prolonged deficiency of iodine results in enlargement of the thyroid, this enlargement being called goiter. While the requirement of the body for iodine is very small, even this small amount seems to be unavailable in many places.

In 1923, Dr. J. F. McClendon studied the iodine content of drinking water from various parts of the country in relation to the amount of goiter among recruits in the United States Army coming from various districts. He showed a definite correlation in this way. Recently surveys have been made of the soil of Nebraska and of South Carolina, which indicates that Nebraska water supplies in general contain sufficient iodine for the maintenance of thyroid equilibrium and that Nebraska food materials are not low in iodine content. Nebraska is apparently one of the non-goitrous states. An iodine map of Nebraska based on analyses of drinking water shows how the various portions of the state vary in relationship to the availability of this substance.



An iodine map of Nebraska based on analyses of the drinking water

The legislature of South Carolina created a commission and provided funds for making studies of the mineral elements of foods grown or produced in that state. The laboratory of the Medical College of the State of South Carolina has been investigating the subject with relationship to iodine. The accompanying table gives the iodine content of some South Carolina vegetables as compared with those coming from California and Oregon:

*Iodine Content of Some South Carolina Vegetables Compared with Results Published by McClendon for Vegetables Produced in California and Oregon**

	South Carolina Analyses by Remington	California Analyses by McClendon	Oregon Analyses by McClendon
String beans	429	...	29
Beets	227	8.0	19
Carrots	197	8.5	2.3
Lettuce	754	...	..
Peas	197 (ripe)	8.4 (green)	..
Potatoes	211	...	..
Spinach	694	26.0	19.5
Soup vegetables	...	...	13.5
Squash (summer)	716	...	..
Sweet potatoes	98	...	..
Tomatoes	273	17.5	..
Asparagus	285	12.0	..
Cabbage	336	...	..
Cucumbers	523	...	..
Egg plant	338	...	..

*The tables are reproduced from a paper entitled "The Potato as an Index of Iodine Distribution," by Roe E. Remington, F. Bartow Culp and Harry von Kolnitz, read before the Section of Agricultural and Food Chemistry of the American Chemical Society, Columbus, Ohio, May 1, 1929. The results in these tables are given in terms of parts per billion of iodine in the dried vegetable.

There is shown to be a definite correlation of iodine content with distance from the sea. The preliminary analyses indicate also that foods rich in iodine are rich in iron and manganese.

Ringworm of the Feet

A DISTURBANCE which is causing increasing concern to physicians is the ringworm of the feet which has been exceedingly prevalent in the United States in recent years. The spread of the golf club, the gymnasium, the swimming pool, and similar places where men, women, and children walk about barefoot apparently has led to a wider dissemination of the organism that attacks the skin between the toes and produces itching, exudation of fluid, and maceration of the tissue.

Physicians in charge of the health of students in the University of California made a survey of the feet of students in that institution and found that 78 percent of the men and 17 percent of the women had ringworm of the feet. Moreover, almost 10 percent of the men had an extension of the ringworm to the thigh or groin. The investigators explained the difference in percentage of infestation between men and women, in this particular case, by the fact that women students and attendants are obliged to provide and wear rubber shoes and under no circumstances are permitted to walk in bare feet on the floors of showers or runways in the swimming pool or gymnasium. The men, however, occupy an antiquated gymnasium and constantly walk about in their bare feet.

They also believe that women students have less ringworm of the feet than men because their habits are cleaner, they observe a higher type of personal hygiene, they perspire less than men, and they wear lighter low shoes.

The authorities caution men particularly against drying the thighs with a towel after it has been used to dry the feet.

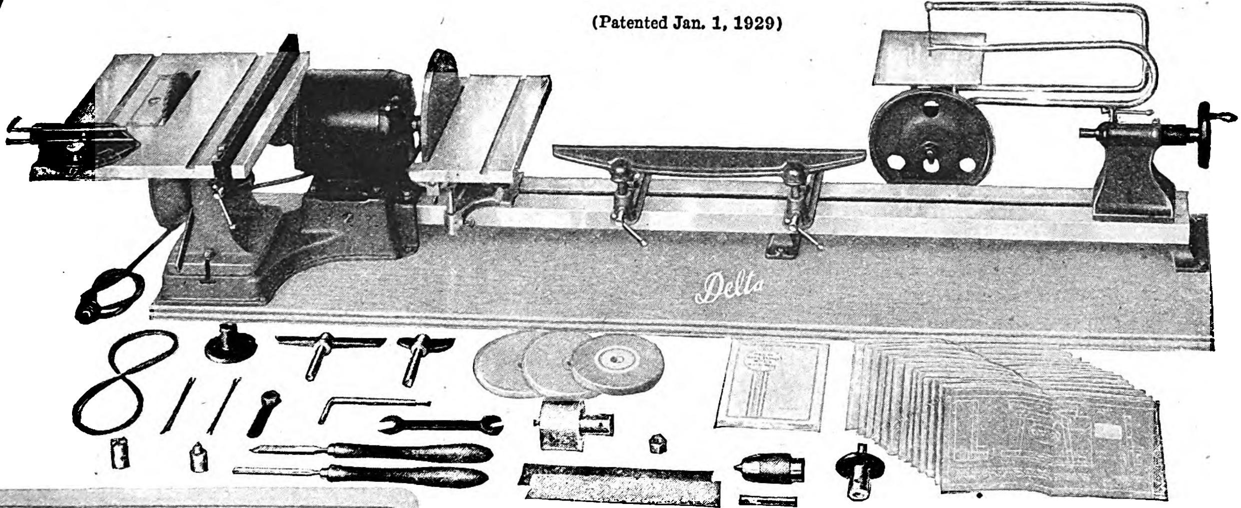
Radioactive Waters

THE sufferer with chronic rheumatism is notoriously a victim for all sorts of new cures. The disease is chronic and tends to get better and worse at intervals, and so each new cure seems to bring about improvement. Among the various devices that have been particularly vaunted in recent years are apparatus of all kinds containing or alleged to contain radium. In a recent consideration of this subject, *The Journal of the American Medical Association* has said:

"Whenever a new substance is identified by the research of chemists, whenever a new force is developed through the investigations of the physicists, whenever a philosopher propounds some new concept in the field of thought or mental activity, an inspired charlatan or promoter is likely to seize on the substance, the device, or the idea and exploit it for the cure of disease as a means of personal gain. The history

Announcing The New "1930" Models "Delta" Woodworking Units

(Patented Jan. 1, 1929)

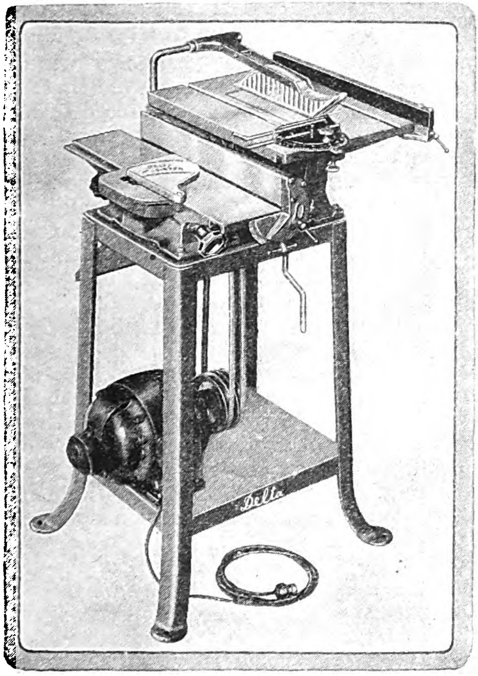


"Delta" Electric Handi-Shop

A complete Motorized Workshop for craftsmen, including all necessary equipment for Circular Sawing, Wood Turning, Scroll Sawing, Sanding, Drilling, Grinding and Buffing.

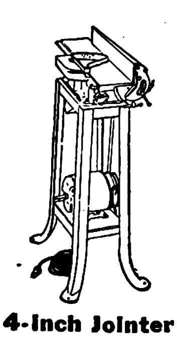
Practical Design — Dependable Quality — *Plus* Many Exclusive Features —

that's what you find in every woodworking unit bearing the Delta trademark. Craftsmen, artisans, farmers, mechanics—all who use wood in their daily labors or spare-time hobbies—are delighted with the sturdy construction, splendid efficiency, and moderate cost of Delta equipment. They appreciate keenly such exclusive constructional features as the Patented Tilting Tables, Automatically-oiled Bronze Bearings, Heavy U-Shaped Lathe Bed, Circular Saw Raising Lever in the Handi-Shop—the new Welded Steel Stands, Graduated Fence, Practical Rip Gauge, Graduated Miter Gauge, and the convenient arrangement, in the new Delta Jointer and Circular Saw Units, which can be used with your motor, if desired.



Combination 4-inch Jointer and 8-inch Circular Saw Unit

mounted conveniently on welded steel stand. Both machines can be used together or separately. Furnished with or without motor.

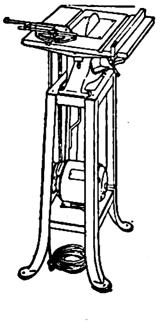


4-Inch Jointer Unit

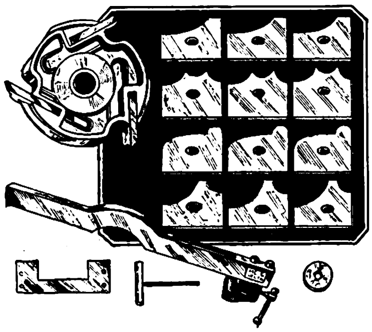
of new, practical design. Mounted on stand. Furnished with or without motor.

8-Inch Circular Saw Unit

mounted separately on sturdy, welded steel stand. Furnished with or without motor.

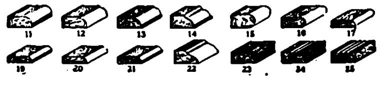


New "*Delta*" MOULDING CUTTER



Cuts Over 50 Moulding Shapes With Only 4 Sets of Blades

High speed blades produce over 10,000 cuts per minute at 3500 R.P.M. Blades require no individual adjustment. Quickly and easily locked in position. Special guide fence. Unusually low price.



10 Day Trial

Easy Terms

For complete details and full description of the new 1930 Delta line, send coupon for FREE illustrated literature. Shows many items of interest to those who work with wood. You will learn, also, how you can try any Delta equipment for 10 days under actual working conditions at our risk. Choice of three convenient payment plans. Mail coupon TODAY!

DELTA SPECIALTY CO.
Division of
DELTA MANUFACTURING CO.
1661-67 Holton St. Milwaukee, Wis.
DEPT. S.119

DELTA SPECIALTY COMPANY, Dept S.119
Division of "Delta Manufacturing Co."
1661-67 Holton St., Milwaukee, Wis.

Please send me FREE, illustrated literature describing 1930 model "Delta" Woodworking Units. Also details of 10 Day Trial Offer and Easy Payment Plans.

Name...
Address...
....

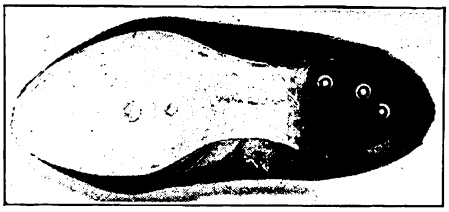
of medicine is replete with records to substantiate this statement. Gold cures, electric cures, magnetic cures, radium cures, and cures by all sorts of means of re-enforcing the power of suggestion, have been collected by the hundreds, and their names carefully indexed in the files of the Bureau of Investigation of the American Medical Association.

"Not many years have passed since the Council on Pharmacy and Chemistry, basing its decision on the then available evidence, admitted to New and Nonofficial Remedies various preparations containing in solution radium or radium emanation (radon), and various devices for causing radium emanation to pass into drinking water. True, the evidence was not extremely well controlled or profuse in amount, but there seemed to be a demand by physicians for such preparations and the Council considered it worth while to set up at least minimum standards of radium content or radium activity. Actually, innumerable preparations were on the market which contained insufficient radium to have any demonstrable effects. There were jars for conferring radio activity on the waters they contained with not enough radium in the walls of the jars even slightly to agitate the leaf of an electroscope. A considerable period of time has elapsed since such preparations first became available. The evidence in support of the contention that radioactive drinking waters are useful for the control of disease or for the benefit of human health has not been profuse in amount or inspiring in scientific value. Indeed, a survey of more recent publications inclines to a dismissal of the entire matter as unproved and unsubstantiated. For this reason no doubt, the Council on Pharmacy and Chemistry has issued the following statement:

> 'From an examination of the available evidence, it appears that the value of the internal use of radium solutions or of water containing radon in chronic arthritis, gout, neuritis and high blood pressure is not demonstrated by controlled clinical evidence; that in spite of many years of trial, acceptable evidence has not become available and until such evidence does become available the Council has decided not to accept generators for the production of water charged with radon or radium solutions intended for intravenous use.'

"The announcement by the Council on Pharmacy and Chemistry disposes of the claims made for all sorts of solutions and for the devices to be used in preparation of such solutions, whether they contain considerable amounts of radium or merely enough to confer activity resembling the flavor of chicken soup when the chicken has had to do double duty as fried chicken and chicken soup flavor. Today there are offered both to physicians and directly to the public solutions of radium and of radon, for drinking, for bathing, and for injection, with claims of virtue not only in the conditions mentioned in the report of the Council but also for anemia, rejuvenation, regeneration, leukemia, boils, blackheads, and pimples.

"Rejuvenation has become a catchword for promoting all sorts of strange preparations and apparatus. The venders capitalize suppressed wishes and desires and exploit all that the power of suggestion is able to do for the impotent. This they do, let it be emphasized, whether or not the devices provide any considerable amount of radium activity. But the statement by the Council settles the matter regardless! In one of the dialogues of the two 'Black Crows,' Moran imitates the blowing of a trumpet. In mock agony Mack responds, 'Even if that was good I wouldn't like it.' Of the radioactive drinking waters it may now be said: 'Even if they did have some radioactivity, there is no evidence that they would have any value.' "



Shoe combining several good features, which was improperly fitted

Right Shoe or Wrong Shoe

ALTHOUGH the introduction of the automobile took the people off their feet, human beings still spend a considerable amount of time in the upright posture and the weight of the body on the feet brings about all sorts of foot disorders associated with vague pains and disturbances. Dr. A. J. Buka, in a recent issue of *The Journal of the American Medical Association*, says that this is very injurious to health, particularly after middle age is reached. In women, most foot disorders come from wearing short shoes with high heels because they still want to wear shoes which will make their feet seem smaller. The effects of high heels are to push the toes to the front of the shoe, with the development of callous and hammer-toes. In men, the chief trouble comes from wearing shoes that are entirely out of shape with the lines of the foot.

Doctor Buka suggests that the chief use of the shoe is protection and support with comfort and durability. Soft leathers are not recommended, since such shoes cannot be kept in good form. He recommends shoes with a semi-round or medium box toe with blucher type uppers, and an extra long counter whereby the shoe is made to fit better over the arch and instep. Close adjustment is brought about through snug fitting of the heel by tapering the back portion of the counter upward. The shoe, when laced, should not produce pressure anywhere beyond the joints of the small bones of the foot and there should be in this way freedom of movement of the toes.

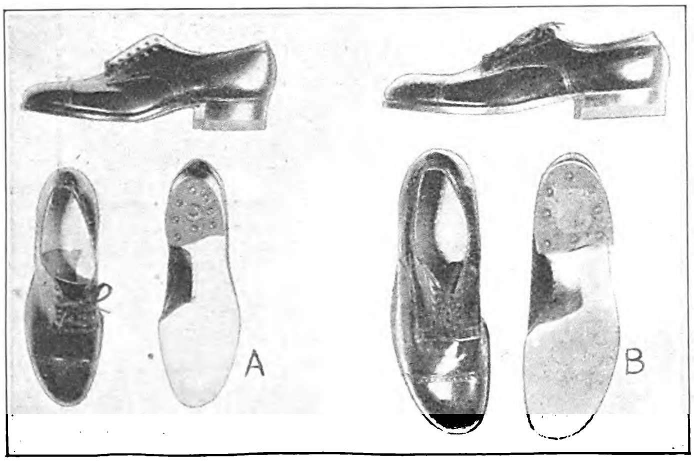
A built-in arch is helpful for some people. The extension sole helps the foot because the foot spreads when the person walks. For general usefulness, the oxford is preferable to the high top. Most of the authorities now recommend a rubber heel over leather, one inch to one and three eighths inches in height for men, and one and one quarter inches to one and three quarter inches for women.

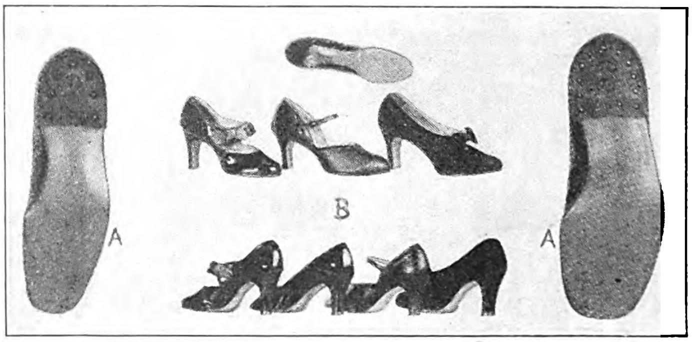
Tularemia in Russia

SINCE the time years ago when Dr. Edward Francis discovered that "deer-fly fever" in the west was caused by a germ which transmits it to man through rats, squirrels, and rabbits, investigations have been carried out on this disease all over the world. The disease, generally known as tularemia, has been found in almost every state in the United States and many a person has been infected while preparing fresh rabbit meat for food.

The records are now available of three extensive outbreaks of this disease in Russia. In the Russian cases the disease was brought about by the attempts of the peasants to catch water rats by throwing harpoons at them during the time of the flood. When the harpoon is withdrawn from the body, the blood of the animal runs out on the hands of the person and produces infection.

It will be remembered that the United States Public Health Service warned people against eating fresh rabbit meat when the rabbit seemed lazy and disinclined to run. During the flood, it was the sick water rats that were more easily harpooned and, these were the ones most likely to spread tularemia.





At left: Types of shoes considered to be correct for good feet. *A* indicates shoes for women, and *B* are shoes for men. *Above:* These types of shoes are considered incorrect for the preservation of good feet. At *A* and *A* are shown the soles of mens' shoes and at *B* are womens' shoes

"for heaven's sake—

STAND UP STRAIGHT!"

"FOR centuries, irritated parents tired from the day's work or quailing at the prospect of it, have been lying back in their favorite chairs and snarling at their offspring, for heaven's sake to stand up straight"—writes Armitage Whitman, M. D., in November HYGEIA, the health magazine of the American Medical Association. He goes on to ask—

"How may we transform a round shouldered, pot bellied, hollow backed, knock kneed, flat footed child, into a self respecting physical and mental specimen that we can regard not only without a shudder but perhaps even with some degree of pleasure?"

In "Proper Posture," Dr. Whitman reveals a rare sense of humor and a delightful style He entertains you while laying down definite, concrete ways for obtaining and maintaining correct posture. His article, like all HYGEIA articles, is a treat for everyone who enjoys straightforward facts about health problems.

November HYGEIA Brings These Features Too—

"Diseases of Some Famous Characters of History"

Caesar died a violent death in the chamber of the Roman Senate—Napoleon died from cancer of the stomach. But is there any proof that these two famous characters in history were epileptics? Contrary to general belief, George Washington did NOT die from diphtheria. What was his fatal illness? James O. Nall, M. D., answers these questions and gives other reliable information on "Diseases of Some Famous Characters of History," in November HYGEIA.

"The Sanity of the Criminal"

By an understanding of the individual offender, crimes are punished more suitably and society is furnished with the maximum degree of protection. Enter the psychiatrist—the specialist in mental disorders who is performing a valuable service in criminal courts. Winfred Overholser, M.D., psychiatrist in the Massachusetts courts, writes interestingly on a vital subject, "The Sanity of the Criminal."

"Control of Pernicious Anemia"

The germ of the idea of liver feeding in anemia dates back just one decade. From over the butcher's counter came the public's first inkling of the use of liver in treating that insidious disease—pernicious anemia. In "The Control of Pernicious Anemia," Julian W. Brandeis analyzes this dread malady and tells of the recent successful advances to combat it.

Introductory — Offer —

6 Issues for $1.00

To New Subscribers Only

AMERICAN MEDICAL ASSOCIATION, 535 N. Dearborn, Chicago.
Enclosed is $1.00 for which send me HYGEIA for six months, beginning with the November issue.
Name..............................
Address..............................
....

In Addition

HYGEIA for November is packed from cover to cover with timely, interesting articles on the thing you value most of all—health! You'll want this issue which contains besides the above features and the regular departments: "The Aim of Mental Hygiene", "Phthisiophobia", "When the Doctor Takes a Blood Count", "A New Foster Mother", "Retrieving the Carrot", "Prince Slipshod and Doctor Tidy", "Simple Lessons in Human Anatomy — The Alimentary Canal", "How Undesirable Immigrants Are Discovered", etc. Mail the coupon and $1.00 for six months of HYGEIA. The magazine through which outstanding medical authorities talk to you in the quiet of your own home, just as your family physician would if he had the time and opportunity. The regular price of HYGEIA is $3.00 per year.

HYGEIA
THE HEALTH MAGAZINE
25 Cen
The Sanity of the Cri
Nov., 1929
Proper Posture

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

New Regulations for Airplane Pilots should be studied by everyone connected with the aviation industry. The new regulations were prepared by the Department of Commerce in co-operation with the industry to protect the flying public and aid the aeronautic industry by assuring competency of operating personnel. *Department of Commerce, Washington, D. C.—Gratis.*

The Airplane, Technical Regulations No. 1170-65 (20 cents), and Airship Mooring Devices, Technical Regulations No. 1170-266 (five cents), are recent publications of the War Department's Air Corps, of interest to civilian and commercial flyers and others interested in aeronautical developments and official regulations. *United States Government Printing Office, Washington, D. C. —Cost noted above.*

Aerial Photographic Surveys in Southeastern Alaska, Bulletin 797-E of the United States Geological Survey, is a competent description of the aerial mapping operations of the government geologists, with the co-operation of the Navy Department, Forest Service, Bureau of Fisheries and other bureaus interested in the project. *United States Government Printing Office, Washington, D. C.—15 cents.*

Industry

Report of the Engineering Foundation shows the progress made by the joint research organization established in 1914 by the American societies of civil, mining, mechanical, and electrical engineers. *Engineering Foundation, Engineering Societies Building, 29 West 39th Street, New York.—Gratis.*

American Standards Year Book for 1929, shows important developments in the national standardization of almost every major American industry. The review covers mechanical, electrical, building, transportation, mining, textile, and many other industries. *American Standards Association, 29 West 39th Street, New York City—Gratis.*

America's New Frontier is the title of an industrial study which shows the growing importance of small towns and the trend toward decentralization of industry, due in part to the availability of electric power. *Middle West Utilities Company, Chicago, Illinois—Gratis.*

Fertilizer, Bulletin No. 36 of the series entitled "Commodity Prices in their Relation to Transportation Costs," deals primarily with prices paid by farmers for fertilizer, the frieght rates for same, and general facts regarding the economic phases of the fertilizer industry. *Bureau of Railway Economics, 1024 Transportation Building, Washington, D. C.—Gratis.*

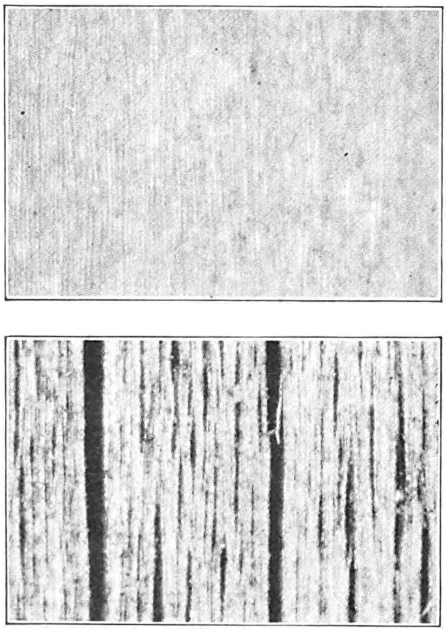
Annual Statistical Report of the Iron and Steel Institute contains the statistics of the iron and steel and allied industries of the United States and Canada for the year 1928 and preceding years. *American Iron and Steel Institute, 75 West Street, New York City—Gratis.*

Wood

Wood Floors is a brochure prepared to inform the home owner or prospective home builder about popular designs and architectural treatment for residential floors. It is handsomely illustrated with photographs showing representative floors in well-designed homes. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

Protection Through Selection is a brief presentation of salient facts concerning hardwood lumber specifications, showing advantages to be secured by the use of hardwoods of uniformly fine texture and close grain. *Appalachian Hardwood Club, Southern Railway Building, Cincinnati, Ohio—Gratis.*

Weathering Effects that Paint Retard tells by means of pictures the story of unprotected wood exposed to the weather. *Forest Products Laboratory, United States Forest Service, Madison, Wisconsin.—Gratis.*



Comparison showing the effect of the weather on wood protected with paint and a similar sample left unprotected, aged prematurely

The Strength of North American Woods, Department of Agriculture Miscellaneous Publication No. 46, by H. S. Betts, is a study containing handy reference tables showing the strength of 129 different species of woods growing in the United States. The report is based on the results of about 130,000 tests made during the past 15 years at the Forest Products Laboratory in Wisconsin. *United States Government Printing Office, Washington, D. C.—Five cents.*

Painting and Varnishing is a guide book, beautifully illustrated in color, for assisting the home owner interested in preserving and beautifying his house by the use of paint, varnish, lacquer, and enamel. The booklet covers every phase of the subject, and the suggestions given are reliable, unbiased, and in good taste. *Save the Surface Campaign, 18 East 41 Street,. New York City—Gratis.*

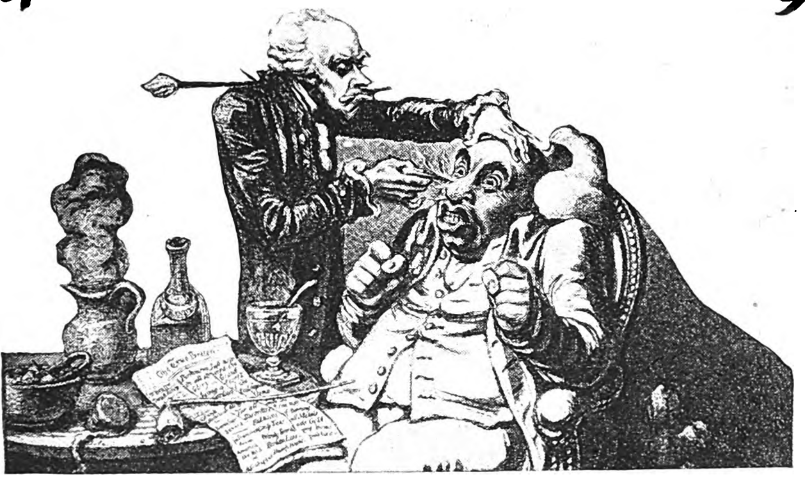
The Gluing of Wood, by T. R. Truax, (Department of Agriculture Bulletin No. 1500) has been published for the purpose of bringing together essential information about glues and gluing, to set forth important principles of control in gluing operations, and to describe methods that have proved successful in commercial practice. *United States Government Printing Office, Washington, D. C.—25 cents.*

Miscellaneous

Revealing the Technical Ascent of Man in the Rosenwald Industrial Museum, by Waldemar Kaempffert, is an interesting description of the place of the industrial museum in our present civilization. The famous Deutsches Museum is described, and figures in numerous illustrations. The paper is a reprint from the *Scientific Monthly* for June 1929. *Museum of Science and Industry, Chicago, Illinois—Gratis.*

Report of the National Committee on Calendar Simplification, recently submitted to the Secretary of State, contains this comment by Arthur M. Hyde, Secretary of Agriculture, "The report impresses me as a comprehensive survey of the public sentiment in the United States on the reform of the calendar. It seems the time is near at hand when the adoption of one simple universal calendar by all the nations of the earth will confer important benefits upon all humanity and our posterity." *Mr. George Eastman, Chairman, 343 State Street, Rochester, New York—Gratis.*

Suppose your doctor did this to you



Perkins's Metallic Tractors—which in this case are being exercised to cure a "jolly" nose—are drawing jets of flame from the organ in question

Suppose if you had a bad cold you were liable to be put in a hospital bed with four or five other people—dying, perhaps dead, of everything from typhus to childbirth. ***Suppose*** when you had a slight wound the doctor poured boiling oil in it to avoid infection.

Suppose during an operation you were held struggling on a table by burly attendants instead of being given an anaesthetic. ***Suppose*** when you fell ill your doctor dosed you with antimony, bitters, rock salt, violets, beet root, cinnamon, cochineal and aloes—and plastered you with Burgundy pitch and pigeon dung.

Horrible Suppositions—yet all these things and many more might have happened to you in the days before medicine and surgery became what we know them as today. The strange and terrible story of the attempts at curing mankind has been finally set down in one of the most fascinating books ever written for the general reader.

Now for the first time you can read the fabulous story of medicine, written so that you can easily understand it, in one volume by one of the greatest authorities on modern medicine.

You can read of the extraordinary medical and surgical practices of other ages—in Egypt and Greece, in Europe of the Middle Ages, the Renaissance and the earliest days of modern medicine—all the superstitions and horrors from which we have finally been freed.

Illustrated with 150 old engravings and woodcuts—alone worth the price of the book—this extraordinary account of the conquest of superstition in medicine will enthrall you throughout with its wealth of anecdote and out-of-the-way information. Thousands of facts you never dreamed of are assembled before you—things you should know yourself—many things you would like to be able to talk about. Sign the coupon now and get the book for five days' free examination.

DEVILS, DRUGS and DOCTORS

by Howard W. Haggard, M. D.

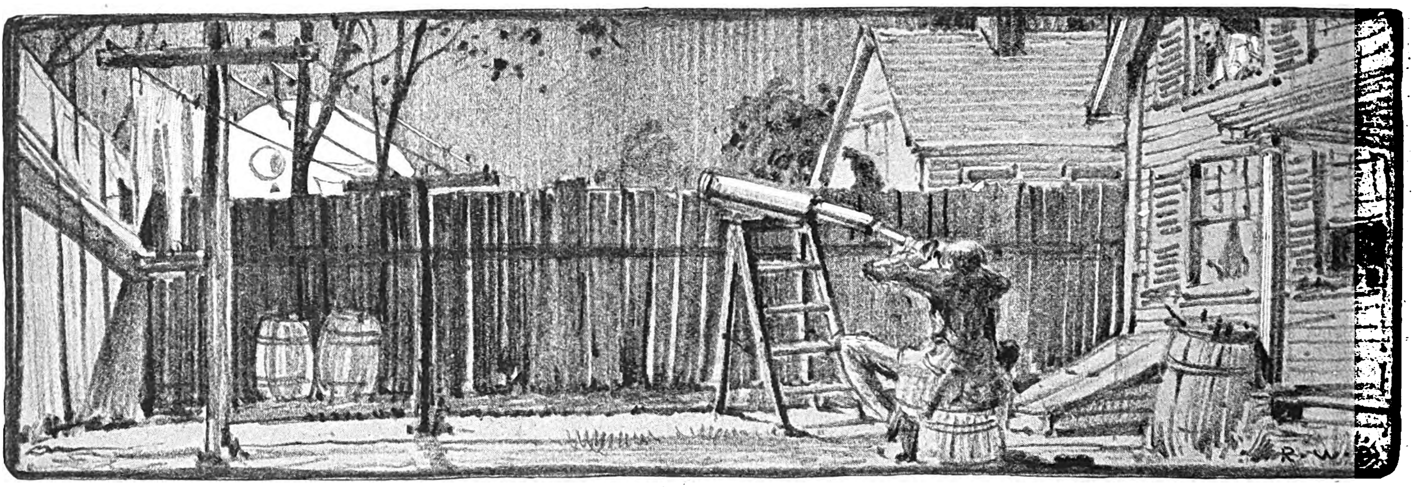
Professor of Applied Physiology at Yale University

FREE EXAMINATION COUPON

HARPER & BROTHERS S.A. 11
49 East 33rd Street, New York City
Send me for 5 days' free examination one copy of
DEVILS, DRUGS AND DOCTORS, $5.00
☐ I will remit $5.00 within 5 days, or return the book.
☐ I enclose check. ☐ Send C. O. D.

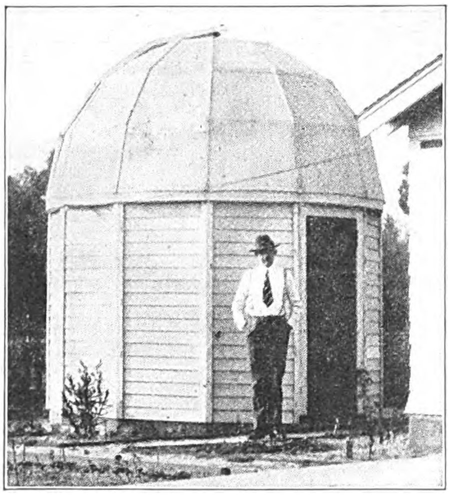
Name...

Address..



The Amateur Astronomer

PREVIOUS to the publication of "Amateur Telescope Making," in 1926, there were a few amateur workers who, however, were mainly without adequate instructions. Thus their work was greatly prolonged. One of these was Mr. E. H. Morse, 2401 Mar Vista Avenue, Altadena, California, who in sending in a description of his telescope emphasizes the fact that his early work would have been made easier and shorter if he had possessed good instructions. Mr. Morse, who is a printer, sends us his story already set up in type and printed in galley form.



Mr. Morse and his trim observatory

"I have been interested in astronomy and telescope making for many years," he writes. "My early attempts at the latter were amusing but instructive failures. All this was changed, however, when I happened to see Richey's papers in the SCIENTIFIC AMERICAN Supplement which made it easy to prepare proper abrasives and tools, and I determined to make an eight-inch telescope at the earliest opportunity. I made a machine somewhat along the model of Richey's but using belts instead of gears.

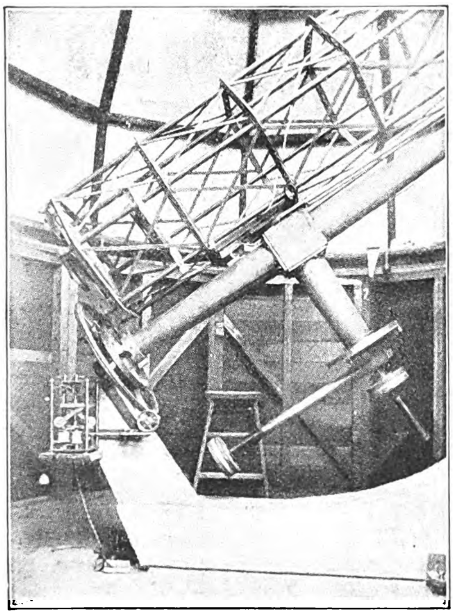
"The cutting of the disks was done on the machine. The first tool I used was cast iron, used as it came from the mold but dressed down with a file as the grinding showed what its proper shape should be. My first mirror failed to show any considerable lights and shadows on the Foucault test, which caused me to think that there must be something wrong with the test; however, upon trying it on the moon, it behaved so well that I decided to mount it and use it.

"I then decided to try to make a better mirror and, using a glass tool and other improved methods, expected to exceed my first attempt easily, but was somewhat surprised to find that I couldn't even equal it until after many months of work.

"Having succeeded in my eight-inch, I decided upon a very ambitious program of making a 15-inch, with building, dome, proper mounting, clock drive, push-button slow motions, setting circles, and other accessories. Upon this work I have been engaged in my spare time since about 1913.

"The electric drive is a slow-speed motor controlled in this way: A Watt's governor retards the position of the commutator if the speed is too high or advances it if the speed is too low, thus maintaining a constant rate of speed. It is entirely successful, the cost was much less than the gears in the usual clock drive, and it never needs to be wound up.

"All my work would doubtless have been made easier and shorter if 'Amateur Telescope Making,' the SCIENTIFIC AMERICAN instruction book, had been published sooner."

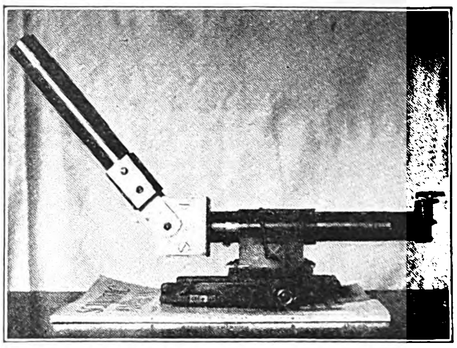


Morse 15-inch reflector, with clock

HOW well professional and amateur astronomers co-operate is illustrated by an incident involving Dr. Robert S. Richardson of Mount Wilson Observatory, acting in the capacity of Sherlock Homes, and Mr. A. R. Dunlop, R.R.2, New Westminster, B.C.

Mr. Dunlop had sent the Telescope Editor the following communication:

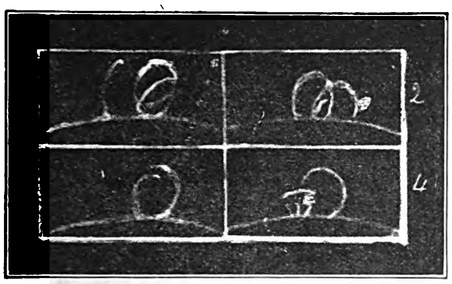
"I am sending a photo of a pencil sketch of a prominence as I saw it with my spectroscope. It represents the change which took place in one half hour, August 19, 1927.



Mr. Dunlop's simple spectroscope

"I would advise all amateurs who can do so to construct the Hale spectrohelioscope, but I also feel that there are dozens who could easily make a simple spectroscope but who could not afford a grating for spectrohelioscope. It is to these amateurs that I would like to deliver a little message, as the results on prominences with a spectroscope costing not more than 10 or 15 dollars to make, are quite surprising.

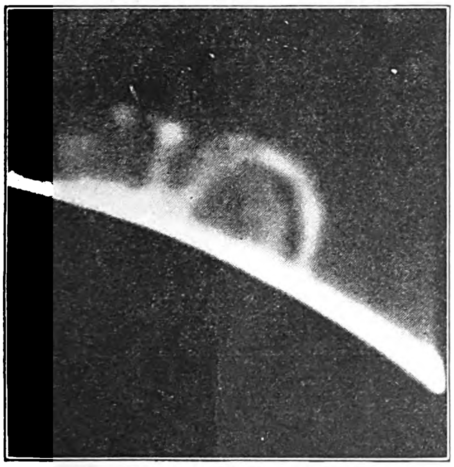
"I am using the polar heliostat form of mounting as shown on page 50, Number 4, of 'Amateur Telescope Making,' but a spectroscope could be used with any equatorially mounted telescope. The Springfield or Pasadena mountings are especially suited to the job, owing to the fixed eyepiece. A four-inch reflector is just the thing for this purpose, and it is quite large enough. A long-focus telescope is not so good, as only a small portion of a promi-



Solar prominences drawn by Dunlop

nence can be seen at once with a large image on the slit."

It was suggested to Mr. Dunlop that he send prints of the same photograph of his drawing of a solar prominence to Dr. Richardson, who specializes in solar research at Mount Wilson Observatory. Dr. Richardson immediately went to the files of plates at the Observatory and located photographs of Mr. Dunlop's prominence. His letter to Dunlop is as follows: "I was very glad to examine your excellent drawing. It enabled me at once to identify the prominence on our plates. There were several photographs of this prominence, and also an *Ha* spectroheliogram of the spot in which the prominence originated. I enclose some enlargements of both.



Spectroheliogram of same prominence

"A special series of observations had been made on this object, but we had quit at 2 P.M. Your drawings indicate that you observed the prominence shortly before it 'blew up.'

"Prominences of the eruptive type are

Prominence originated in this spot

Handling Heavy Loads

The present quick, efficient methods of handling heavy loads owe much to wire rope; for in nothing else is sufficient strength so nicely combined with flexibility and small diameter.

Manila rope, equal in strength to 1-inch Yellow Strand Wire Rope would be 3½ inches in diameter.

The Broderick & Bascom Rope Co., manufacturers of Yellow Strand, were pioneers in the industry. All the wire for their famous brand is drawn to their own specifications, in the famous Sheffield Steel District.

A *strand of yellow* distinguishes Yellow Strand in appearance; economy distinguishes it in service.

This company also makes all standard grades of wire rope for all purposes.

B&B Aerial Wire Rope Tramways are cutting haulage costs at many industrial plants. Investigate.

BRODERICK & BASCOM ROPE CO.
St. Louis, Mo.
Eastern Office and Warehouse : 68 Washington St., New York
Western Offices: Seattle and Portland, Ore.
Factories: St. Louis and Seattle

Yellow Strand WIRE ROPE

LR 648

The Equivalent of
A College Education
In This One Fascinating Volume

Now you may have all that the graduate of a general four-year College course takes with him into social and business life. The broad cultural background and the comprehensive grasp of general knowledge CAN BE YOURS and with it the ability and confidence required for positions of leadership in any circle. No one who was denied a college education need any longer be placed at a disadvantage among cultured, educated people. An amazing book is now at your service—in reality SIX books in ONE offering the easiest, the most effective, the most lasting, the most interesting method of self-education. A few minutes of reading daily will give you a liberal education in an amazingly short time.

6 Great OUTLINES
In a Single Volume

Think of getting, *in one volume*, The Outlines of HISTORY, SCIENCE, LITERATURE, ART, PHILOSOPHY, RELIGION—the six books you must read to be up to date on every subject! A tremendous range of knowledge, yet each of the six Outlines is thorough and complete. Here is the knowledge that forms the background of cultured, educated people—that can win for YOU the leadership and admiration of your associates—that brings SUCCESS. Written simply to be easily understood; concisely to save your time; in lively, fascinating style to be easily remembered.

THE OUTLINE OF MAN'S KNOWLEDGE

Written by Clement Wood with such success that the Pittsburgh *Sun-Telegraph* calls it "A University in itself"; and the Philadelphia *Public Ledger* says it is "The ONE book to read and know." Here is the whole scope of modern education in one thrilling narrative of 700 sparkling pages — the cream of the world's knowledge for quick and easy self-improvement.

Read It FREE

Here is a remarkable opportunity to secure this thrilling book without cost or obligation for a week's free examination. Send no money. The coupon below will bring your copy of the book. If you are not convinced that it is the biggest value for the money you have ever seen, send the book back and owe nothing. If you decide to keep it, pay the remarkably low price on the easy terms shown in the coupon. Don't delay.

Mail This Coupon Today

LEWIS COPELAND COMPANY, Dept. 557,
119 West 57th St., New York City.

Kindly send me THE OUTLINE OF MAN'S KNOWLEDGE, by Clement Wood, 700 pages, illustrated, handsomely bound. Within 7 days I will either return the book or remit $1.50 as first payment, and then $2.00 per month for two months, a total of $5.50. (Ten per cent discount for cash with order. Same return privilege.)

Name..

Address..

City........................ State..............

If outside continental U. S., send $5.50 with order

frequently accompanied by magnetic storms. Our magnetometer records show a violent storm lasting from August 18 to 21, which was probably caused by this spot.

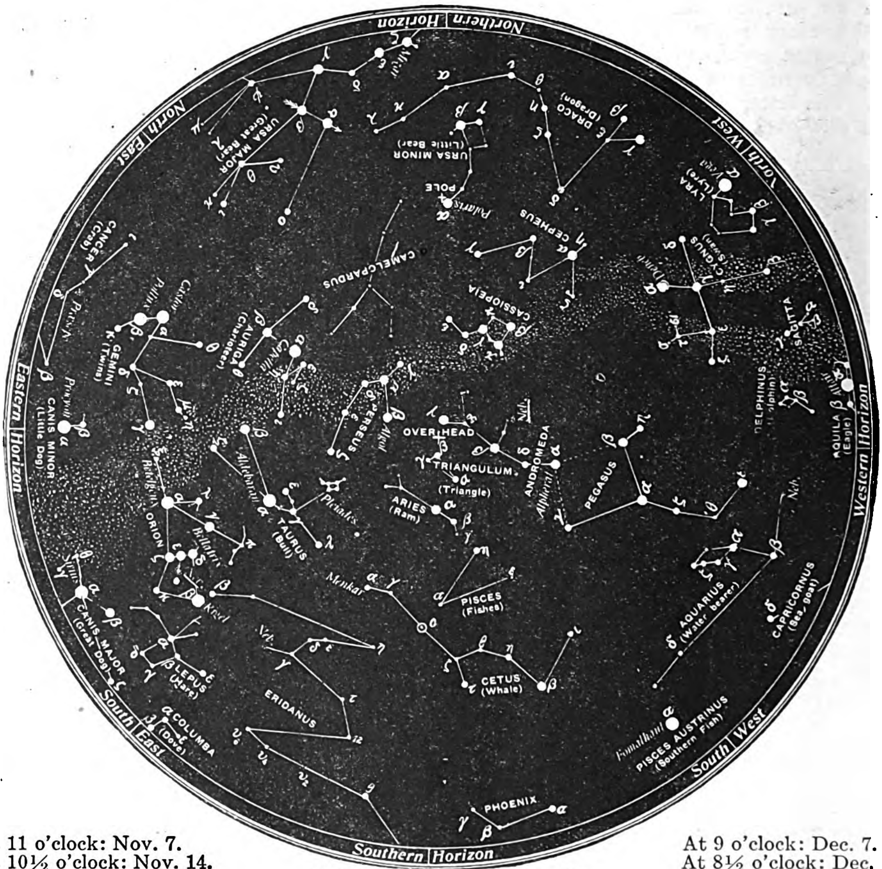
"I should think that very valuable work could be done with small equipment in studying eruptive prominences. Investigation of the relation between magnetic storms and eruptive prominences requires nearly continuous observation, and hence important contributions might be made by amateur astronomers, supplementing the work of large observatories.

"Observation of prominences in different lines of the spectrum is also of interest. The hydrogen lines, of course, are always bright, as well as the D_3 line of helium and the H and K lines of calcium."

MR. W. G. HALE, of the University of Washington Library, Seattle, wishes to borrow a telescope or a mirror for use in connection with astronomy talks he is giving to boys. Volunteers are requested to communicate with Mr. Hale direct—*A. G. I., Tel. Ed.*

The Heavens in November

By PROF. HENRY NORRIS RUSSELL, Ph. D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
URSA MAJOR (Great Bear)
URSA MINOR (Little Bear)
DRACO (Dragon)
POLE
Polaris
CEPHEUS
LYRA (Lyre)
Vega
CYGNUS (Swan)
Deneb
CAMELOPARDUS
CASSIOPEIA
CANCER (Crab)
GEMINI (Twins)
Castor
Pollux
AURIGA (Charioteer)
Capella
PERSEUS
OVERHEAD
TRIANGULUM (Triangle)
ANDROMEDA
PEGASUS
SAGITTA
DELPHINUS (Dolphin)
AQUILA (Eagle)
CANIS MINOR (Little Dog)
Procyon
ORION
Betelgeuse
Rigel
TAURUS (Bull)
Aldebaran
Pleiades
ARIES (Ram)
PISCES (Fishes)
Menkar
CETUS (Whale)
AQUARIUS (Water Bearer)
CAPRICORNUS (Sea Goat)
CANIS MAJOR (Great Dog)
Sirius
LEPUS (Hare)
COLUMBA (Dove)
ERIDANUS
PISCES AUSTRINUS (Southern Fish)
Fomalhaut
PHOENIX

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.
At 9½ o'clock: November 30.
At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

NIGHT SKY: NOVEMBER AND DECEMBER

MERCURY is theoretically a morning star until the 27th and an evening star afterwards, but he can only be seen just before sunrise in the first few days of the month. Venus is a morning star in Virgo and Libra and rises at 5 A.M. in the middle of the month. Mars is an evening star, but too near the sun to be seen. Jupiter is approaching opposition, rises about 6 P.M., and dominates the midnight sky. The telescopic observer may see an instructive sight on the 8th, between 6 P.M. and midnight when the first and second satellites and their shadows cross the planet's disk. The performance is repeated on the 15th, 22nd, and 29th, about two hours and a half later in the evening each time. Saturn is an evening star and sets at about 7.45 P.M. on the first and at 6 P.M. on the 30th. Uranus is in Pisces and comes to the meridian at 8.50 P.M. on the 15th, while Neptune is in Leo and is in quadrature west of the sun on the 26th.

The moon is new at 7 A.M. on the first; in her first quarter at 9 A.M. on the 9th; full at 7 P.M. on the 16th; in her last quarter at 11 A.M. on the 23rd; and new once more at 11 P.M. on the 30th. She is nearest the earth on the 19th and farthest away on the 7th. She is in conjunction with Mars on the 2nd, Saturn on the 5th, Uranus on the 13th, Jupiter on the 18th, Neptune on the 26th, and Venus on the 29th.

On November first there is an annular eclipse of the sun which is just visible in the United States, the sun rising on the Maine coast just before the moon finally leaves its disk. The track of the annular phase extends across tropical Africa south of the equator, out into the Gulf of Guinea, inland again over the Sahara, and into the Atlantic south of the Azores. The partial phases are visible through the whole of Africa and in all Europe east of the line drawn from the Baltic to the Black Sea, and in the near eastern part of Asia.

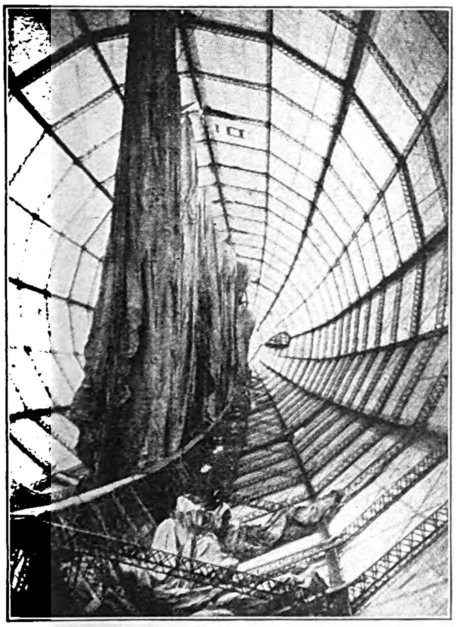
The Scientific American Digest

(*Continued from page* 435)

inspected for flaws. Irregular edges are trimmed off and weak places removed. This often reduces the size of the skin considerably. When finished, the shape is rectangular.

The rectangular skin is then spread on rubberized balloon cloth, previously coated with rubber cement, the edges of the pieces overlapping about 1½ inches. This operation completes the manufacture of the gas-cell fabric.

Rubberized fabric has been used also for the making of gas cells, but, in general, has not been found as impervious to lifting gas as goldbeater skin. Recent developments promise to make available a material that will replace the expensive skincoated cloth.



Interior of a dirigible showing the cells of goldbeater skins in place ready to be inflated

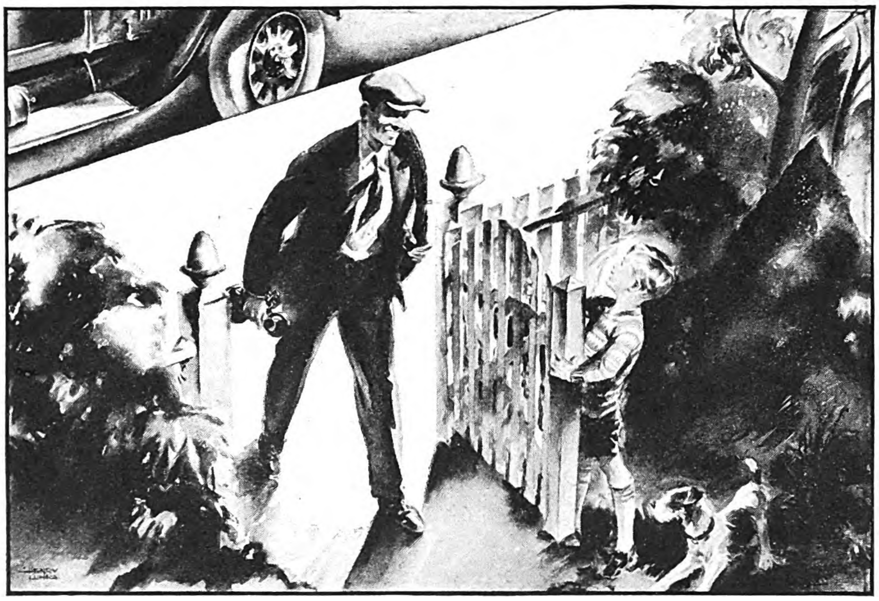
---

Proper Pre-heating Practice in Shop Welding

THE pre-heating facilities necessary in any welding shop naturally depend upon the run of work handled. Cast iron welding forms perhaps a major part of the average welding shop's daily work and it pays the shop manager to give close study to preheating problems encountered in the various types of castings. Small pieces can be preheated by the oxy-acetylene blowpipe and then welded without much difficulty. This method, however, is impracticable for larger pieces. A blacksmith's forge is sometimes used for certain pieces, but with this there is the possibility of overheating or burning the metal on one side, if constant care is not exercised.

The most practical and most economical method of preheating large pieces, particularly where the entire casting is to be heated, is the use of a temporary firebrick furnace. This is built of loose firebrick laid without mortar. It is quickly constructed and can be built to any size desired. Asbestos paper, having holes for draught if necessary, can be used for the top of the furnace. The spacing of the bricks around the base of the furnace assures sufficient draught to raise the piece to the proper temperature.

In order to keep a desired temperature,



800,000 ADDITIONAL TELEPHONES ARE GOING INTO USE THIS YEAR

A million and a half dollars a day

An Advertisement of the
American Telephone and Telegraph Company

MORE than 200 new Bell telephone buildings are going up this year in the United States, 800,000 additional telephones are going into use and new switchboards to care for 3,000,000 additional calls a day. Thousands of miles of new cable, millions of miles of wire, new carrier systems, vacuum tubes and loading coils.

These are a few of the things in the 1929 construction and improvement program of the Bell System which will cost more than 550 million dollars—a million and a half a day.

Telephone growth is essential to the new American civilization of better opportunity for the average man. The Bell System employs more than 400,000 workers, is owned by 450,000 stockholders and serves the people of the nation.

Every day the Bell System is extending its lines to more people, increasing the speed and accuracy of its service, giving greater comfort and convenience in telephone use. All of this is done that each individual may get the most from this means of all inclusive and instantaneous communication and that the nation may be one neighborhood.

This is part of the telephone ideal that anyone, anywhere, shall be able to talk quickly and at reasonable cost with anyone, anywhere else. There is no standing still in the Bell System.

ASBESTOS
All grades of Crudes
and Fibres in large
or small quantities
Sold by
KEASBEY & MATTISON
COMPANY
Ambler, - Penna.
Branches in Principal Cities

Improved Reception
from your present radio
is now made possible
by the—
RADIO
CLARIFIER
$3.00 Postage Prepaid

It clears the tone, decreases interference and increases volume. Overcomes fading of sound. Good for any wave length. Easily installed on inside or outside aerial. Simply cut wire near cabinet and connect between cabinet and aerial by using clips which are attached to Clarifier. Gives wonderful results. Satisfaction guaranteed. Worth many times its cost. Send $3.00 for immediate delivery. Descriptive literature on request.

ROAT & LOHMAN, Dept. 404, Milton, Pennsylvania

America's answer to humanity's challenge

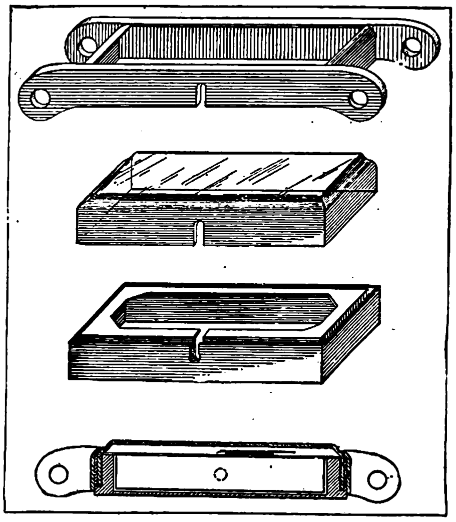
the fire must be regulated occasionally while the welding progresses. This is done by opening or closing the draught holes, re-arranging the asbestos paper covering, moving hot coals from one place to another, or replenishing the fire whenever necessary. This important detail is usually performed by a helper. When the casting has reached an even, dull red heat, an opening is made in the asbestos paper cover just large enough to uncover the weld area, and welding is done through this hole.

After the weld is completed it is just as important to secure proper cooling. The entire casting or piece should be covered with fresh charcoal and brought up to an even heat. With the asbestos covering intact, the finished work should be allowed to cool and contract evenly in the dying fire. It is important that one part does not cool quicker than any other. If this happens the piece may crack due to an uneven "pull."

Preheating and annealing of cast iron is an essential part of welding technique. It is not a difficult feature for the methods of constructing the preheating furnace and governing the preheating temperature are easily understood.

Dustless Wrist Watch

WHILE wrist watches are becoming more popular every day among both men and women, the problem of preventing the entrance of dust under the crystal and of losing the crystal entirely, has been given very little attention. However, a newly invented case for a wrist watch recently put on the market by Adolphe Schwob, Inc., eliminates these two causes of trouble entirely.


The three parts of the dustless wrist watch and how they fit

The new watch case consists of three parts built in such a way as to fit together firmly to form a dust tight case. The accompanying illustrations show that the case proper is a metal box with a groove around its upper edge into which the crystal, which is also a box but is made of transparent material, is inserted. This assembly is held under the main frame, on the ends of which there are pins to hold the wrist strap.

The accompanying illustrations shows the various parts and how they are assembled. It will be noted that the lower edge of the crystal slides deep into the groove in the metal box and that the frame curves over against an offset on the upper face of the crystal.

Veeder-Root Counters
Blanket All Counting Problems
in all industries
METAL INDUSTRIES
AUTOMOTIVE
PUBLIC UTILITIES
FOOD INDUSTRIES
PRINTING
TEXTILE INDUSTRY
RETAILING

At *some* place in the making, conveying or packaging of your product it's *counted*, measured, weighed or re-counted by hand. Right there---Counters will work without pay, without mistakes, without the delays of counting or measuring by hand. When your product comes through it's all totalled up. All ready for the next operation.

There's not a single counting problem that's any problem with Veeder-Root Counters. The line blankets *all* industries; all machine-applications. Write for new Veeder-Root Catalogue to see *which* Counters will best do your job.

Veeder-Root INCORPORATED HARTFORD, CONN. OFFICES IN PRINCIPAL CITIES . . .

Nature of the Physical World

By A. S. Eddington,

Prof. Astronomy, Cambridge

The authors of our science articles—themselves most eminent scientists—are referring more and more to Einstein's theories and this in turn brings up the work of the distinguished author of this book, for Dr. Einstein himself has stated that Prof. Eddington's work has been fundamental. In this book we find him in somewhat different light, for he is writing for the layman on the origins and the fundamental concepts of the physical world. Postpaid (Domestic) $3.90

Course in General Mathematics

By C. H. Currier, Asso. Prof. Math.
Brown University

E. E. Watson, Prof. Math.
Iowa State College

One of the most popular books of its kind that has appeared recently, for all who are associated with industry find at some time or other that we have to solve a problem that arises in our daily work, and this is just the sort of book we need to have available. Algebra, trigonometry, analytic geometry and calculus are treated with clarity and comprehension. An acquaintance with elementary algebra and plane geometry is presupposed. Postpaid (Domestic) $3.70

For Sale by SCIENTIFIC AMERICAN

AIRPLANE DRAFTING

THOUSANDS OF MEN

will make fortunes in Aviation. Airplane Drafting and Designing are the biggest jobs ahead in this fastest growing industry. A new field of opportunity for you is opened in our improved method of training.

EASY TO LEARN. STUDY AT HOME. PAY AS YOU GO. EMPLOYMENT SERVICE.

Write for booklet outlining courses in Airplane Drafting and other aviation subjects, including the famous Weem's System of Navigation—endorsed by Col. Lindbergh, Commander Byrd, Lincoln Ellsworth, Admiral Moffett, etc.

Name..................................

Address..................................

City....................State..........

☐ AIRPLANE DRAFTING

☐ AIRPLANE MOTORS ☐ AIRPLANE MECHAINCS

PACIFIC TECHNICAL UNIVERSITY SAN DIEGO CALIFORNIA

WANTED MEN

To Manufacture Metal Toys and Novelties

Big demand for Toy Soldiers, Animals, 5 and 10c Store Novelties, Ashtrays, etc. We co-operate in selling goods you make also buy them from you. Small investment needed to start and we help you build up. WE FURNISH COMPLETE OUTFITS and start you in well paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life time for man with small capital. CHRISTMAS RUSH is now starting, so if you mean strictly business write AT ONCE for full information.

METAL CAST PRODUCTS COMPANY
Dept. S 1696 Boston Road New York City

BECOME A FOOT CORRECTIONIST

$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.

STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

LEARN WATCHMAKING AND ENGRAVING

By Our Profit-Sharing Plan

OUR GRADUATES SUCCEED

One of our Iowa students started in a very small way—now doing over $30,000 a year. Another in Wisconsin, over $10,000 the first year. Day or night classes. Call or write for FREE BOOK.

Chicago School of Watchmaking
Dept. 404, 549 W. Randolph St., CHICAGO

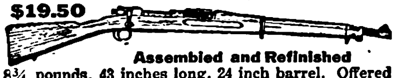
Waterpower Engineering

Home Study for High School Graduates

H. von SCHON, Consulting Engineer
289 Parker Street, Newark, N. J.

SPRINGFIELD RIFLE, Model 1903

$19.50

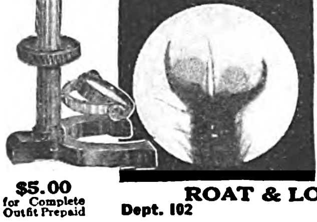


Assembled and Refinished

8¾ pounds, 43 inches long, 24 inch barrel. Offered without bayonet, $19.50. Packing charge 50c extra. Ball cartridges $3.50 per 100. New catalog, illustrated, 380 pages of Army-Navy equipment, pistols, guns, uniforms, saddles, for 50 cents.

Special new circular for 2c stamp. *Established 1865.*
Francis Bannerman Sons, 501 B'way, N.Y. City

Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE



At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.

$5.00 for Complete Outfit Prepaid

ROAT & LOHMAN
Dept. 102 Milton, Pa.

Learning to Use Our Wings

(*Continued from page* 437)

serted and completely fastened per minute.

The metal-clad which has been purchased by the United States Navy Department, the *ZMC-2*, has a cubic capacity of only 200,000 cubic feet, and is therefore too small to show the full possibilities of the type. Nevertheless successful tests and service trials should do much to demonstrate its merits.

We show a number of interesting photographs of the *ZMC-2*, whose general characteristics are as follows:

Length of hull	149 ft. 5 in.
Diameter of hull (max..)	52 ft. 8 in.
Fineness ratio	2.8
Displacement of hull	202,200 cu. ft.
Total ballonet displacement	50,600 cu. ft.
Front ballonet displacement	22,600 cu. ft.
Rear ballonet displacement	28,000 cu. ft.
Ratio of ballonet volume to hull volume	25%
Thickness of skin	.0095 in.
Length of car	24 ft.
Width of car	6 ft. 6 in.
Number of air valves	3
Number of gas valves	2
Number of fins	8
Total fin area	440 sq. ft.
Total elevator area	190 sq. ft.
Total rudder area	95 sq. ft.
Total automatic rudder area	95 sq. ft.
Engines (Wright Whirlwind J-5)	2
Power at 1800 R.P.M.	440 h.p.
Propeller diameter (all metal)	9 ft. 2 in.

FORECAST PERFORMANCES

Gross lift (100% inflation with 92% pure helium at 60 degrees F. 29.92 in. Hg)	12,242 lbs.
Weight empty	8900 lbs.
Useful load	3342 lbs.
Crew (three)	600 lbs.
Fuel (200 gals.)	1200 lbs.
Oil (25 gals.)	200 lbs.
Ballast (50 gals.)	420 lbs.
Radio	180 lbs.
Passengers and cargo	742 lbs.
Range with 250 Gals. (Cruising speed)	680 miles
Maximum possible range (still air)	1000 miles
Maximum speed at 440 H.P.	62±2 m.p.h.
Cruising speed at 220 H.P.	50±2 mp.h.
Static ceiling	10,000 ft.

Physiological Effects of the Spin

In his paper on Spins and Slots presented before the Society of Automotive Engineers, Lieutenant Carl Harper discusses the physiology of the spin. We are not on very certain ground here, but it would appear that the inner ear contains a membraneous labyrinth embracing a fluid called endolymph. Turning rapidly around sets the endolymph in motion, and it is actually a safeguard under normal conditions of life, because the motion of the endolymph transmits warning impulses to the brain.

After a number of turns in a spin, time is required to dampen out the motion of the endolymph. Under certain conditions the pilot's senses, therefore, tell him that he is still spinning, after the spin has ceased. He is then apt to overcontrol and to fall into a spin in the opposite direction. After a few turns there is another equally

Eldis' SPORT GLASS VEST POCKET

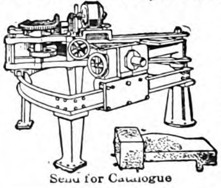
Get the Habit—Carry Them Always in your pocket!

So compact—have them with you at football games, races, ringside and great outdoors—multiplies your pleasure. Different from old style, but powerful with widest field of view (265 yds. at 1000 yds.); 90% luminosity. Beautifully made and finished. Every man or woman would be delighted to receive a gift of these wonderful sport glasses; only 3 1-2 inches long; 1 5-8 inches high (closed); 1 3-16 inches wide. Complete in soft leather pouch. Blue, jade or tan finish $13.50; black $13.

Ask Your Dealer—sent direct if he cannot supply. Money back guarantee. Write for folder "M" Dealers' inquiries invited.

AMERICAN THERMO-WARE CO., Inc.
Exclusive Importers—Est. 1901
16 Warren Street
New York

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe



Send for Catalogue

Standard of the World
Hand and Motor Operated
14 Sizes of Machines

What it costs to bend pipe our way, per bend:

1-inch pipe	5 cts
2-inch pipe	10 cts
4-inch pipe	25 cts
6-inch pipe	60 cts
8-inch pipe	$1.00

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

RADIO FREE CATALOG

AT WHOLESALE PRICES

196 pages of radio bargains. New Screen Grid, all-electric, A. C. Sets in beautiful consoles—also battery operated sets as low as $15.95. Write today.

ALLIED RADIO CORPORATION
711 W. LAKE ST., DEPT. 67 CHICAGO

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG

STEEL LETTERS AND FIGURES

SCHWERDTLE

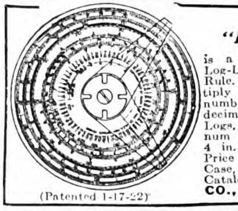
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

AGENTS 500% PROFIT

GUARANTEED GOLD LEAF LETTERS

For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.

METALLIC LETTER CO. 440 N. Clark, Chicago

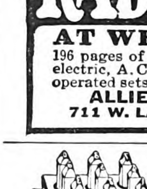


(Patented 1-17-22)

The Midget
"*Five-in-One*" Slide Rule

is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Fabrikoid Case, 50c extra. Sent C. O. D. if desired. Catalogue Free. GILSON SLIDE RULE CO., Stuart, Florida

CHEMISTS



Catalog illustrating 2500 Chemist's Supplies, 5000 Chemicals, Minerals, Drugs, etc., and listing 1000 Scientific Books sent for 50c. Glass Still, as illus. cap. of flask 1 Qt. complete $8.

LABORATORY MATERIALS CO.
637 East 71st Street, Chicago.

GEARS

All Kinds—Small

The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalogue 20

CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

dangerous effect, namely anemia of the brain, the blood being drawn away by heavy centrifugal force. If the spin is greatly prolonged there is haziness, dizziness, and ultimately unconsciousness. There is still another danger in the spin. The centrifugal forces acting on the pilot may increase his apparent weight four times. It is then extremely difficult to clamber out of the cockpit—for a parachute jump. Hence the great interest shown in the recent experiments where a dummy was thrown out through a trap door in the floor of the fuselage, and the ejection of the dummy was aided by the centrifugal force of the spin.

American Passenger Air Transport—II

(*Continued from page* 407)

little through the mouth, so that the pressure on both sides of the ear-drums will be equalized. If you hold your nose and swallow, you will hear a little crack in your ears, caused by the suction of air on the ear drums."

There has been a vast change in the attitude of the airplane operator towards the comfort of the passenger. Three or four years ago a rough open cockpit was considered good enough for the hardy air traveler, who had to dress the part when braving the often icy slipstream of the propeller. Now the large multi-engined cabin plane is more luxurious than a Pullman car.

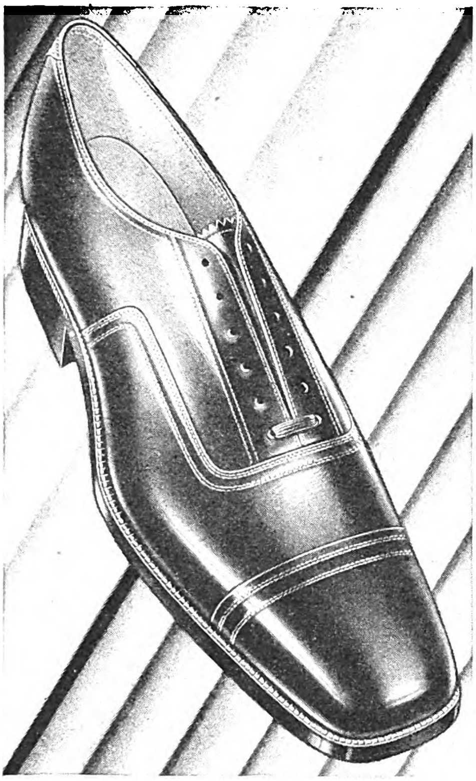
For example, in May 1928 the Western Air Express accepted delivery of the three tri-motored Fokker *F-10's* then described as the fastest and most luxurious airplanes in America. Since that date the planes themselves have altered little, but according to the passenger agent of this company more than 200 refinements have been provided in the latest specifications.

The tilt of the chairs has been changed, so that the passenger is more comfortably seated. The upholstery has been made a little thicker. Additional ceiling lights have been installed. An ornate container is provided for ice water. A convenient smoking stand has been provided with room for matches, ashes, and cigarets. The floor linoleum has been covered with a rug. The baggage compartment has been more compactly inclosed, and a cabin has been provided for carrying foodstuffs, dishes, and cutlery. The passenger agent appears to be quite right in claiming more comfort than in a Pullman!

The airlines seem to be outdoing the railways in other ways in securing the comfort of the passenger. In large machines, when once the plane is under way, the second pilot will pass out daily newspapers. Some lines go so far as to provide magazines. Writing paper and envelopes are always available, with sometimes a comfortable little table. There is always a log book at hand describing points of interest on the trip.

Some of the operators state in their pamphlets that lunch is provided. Others keep a dainty lunch, served on beautiful trays, as a pleasant surprise for the new air traveler. On some private planes electric kitchens and electrical refrigerators have been provided. The transport companies may follow suit.

It is expected that telegraph messages



For the Man who Cares

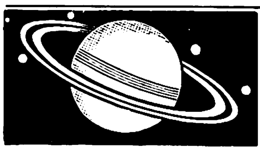
LONG after you would expect any shoe to have lost its shape and its smartness, THE FLORSHEIM SHOE is still giving service . . . It is still shapely . . . still handsome . . . still a pleasure and a credit to its wearer!

THE PICK . . . *Style* M-362

The FLORSHEIM *Shoe*

Most Styles $10

The Florsheim SHOE



ASTRONOMICAL
TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.

BOILER FEED WATER TREATMENTS
of purity and all other required characteristics.
Pamphlet on request
SIME, DARBY & CO., Singapore, S. S.
Agents for Straits Settlements.
UNISOL MFG. CO.,
Jersey City, N.J., U.S.A.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

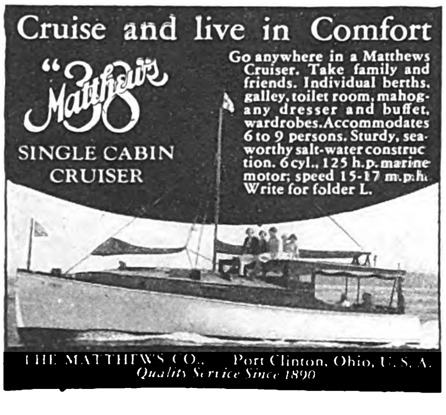
VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

RUSH-ABSOLUTELY FREE!
THIS E-F ANGLE SCREWDRIVER--of tempered crucible Spring steel — has 7 powerful edges for large & small screws. Works under obstructions where others won't—101 other uses. Carries like pen-knife — often more valuable. Sent Free on Receipt of Coupon.
Name ____________
Route No., St. ____________
P. O. City, St't. ____________
☐ Interested in Factory Representative Proposition!
☐ In User Literature! THE FLASH SALES CORP'N
KSA • 4809 N. Ashland Ave., CHICAGO, ILL.
CLIP HERE—MAIL TO
Also FREE ON COUPON—the "$5,000" CIRCULAR giving amazing 125-Picture story of
The "Pocket Machine Shop!"
with its 1-TON POWER-GEAR
It Outgrips a 40-Lb. Vise!
The 'hand-grip' of a tiny Rubber band holds the Hardest-to-Hold thing known against a 300-Pound Pull!
Its 10-to-1 ratio Power-Gear-Transmission gives YOUR hands the 1-TON GRIP of 20 Hands, yet—YOU CAN GRIP A HAIR.
An Automatic Lock-Grip Ratchet Wrench
Speed VISE
Parallel
PLIERS
Plus
No. 3—for all Wire, chain, spring-making, fence work, etc.
No. 2—for all Pipe work, "chewed" nuts in tight places, etc.
No 1, Universal—for ALL Pliers, Nut Wrench, Vise and Clamp, Spring-making Work, etc.
EIFEL-FLASH PLIERENCH KIT
(Say "Eye-fel—Flash") "The T.N.T. of Tools"
You get the amazingly Quicker, Better, Easier, Universal Tool Service of Nos. 1, 2 & 3—Convertible in 1/5 second—in this new 24-Ounce Master Tool Kit—for the Price of One Good Tool; yet it Does the Work of the best other tools Weighing 60 pounds and Costing $50.00!
Hundreds of Thousands of Men and Women are using these wonder Kits to make Homes and Estates more comfortable—Farms, Shops, etc., more profitable; to get more and better service from Auto's and all mechanical devices with a huge saving in money, time and energy!
Used by the U. S. Army and Navy. Just try a PlieRench Kit Once, and you'd no more go back to other tools than to the ancient Ox-cart!
With each Kit a 64-page Manual of Mechanics
A GUARANTEED SUPER-QUALITY PRODUCT (©'29-J.E.)
Makes Splendid Christmas Gifts
ALSO BIG FALL AND WINTER MONEY-MAKER for PlieRench Factory Representatives—Full or Part Time. Amazing Demonstr'n sells at sight—makes $75-$200 weekly all year 'round. Seasonal Demand Doubles Profits. A Ga. Repr. made $97 in 20-Min. Group Sale; a Mich. Repr. $368 in 12 days; another $379 in 5 days. Everybody wants the Kit!
Mail Valuable Coupon Above NOW!

WANTED
For manufacturing and selling by a prominent, long established Massachusetts concern, **special or patented equipment** for Water Storage Reservoirs, Filtration Plants, Irrigation Development. Liberal royalties on exclusive manufacturing basis. Address BOX 193, SCIENTIFIC AMERICAN, New York City.

HAVE YOU AN ELECTRICAL PROBLEM?
WE SPECIALIZE IN "PERSONAL SERVICE", and *solve them for YOU through the mail with Precision Write us now.*
TAHSESAEB, P. O. No. 132, FLUSHING, NEW YORK


Cruise and live in Comfort
"Matthews 38"
SINGLE CABIN CRUISER
Go anywhere in a Matthews Cruiser. Take family and friends. Individual berths, galley, toilet room, mahogany dresser and buffet, wardrobes. Accommodates 6 to 9 persons. Sturdy, seaworthy salt-water construction. 6 cyl., 125 h.p. marine motor; speed 15-17 m.p.h. Write for folder L.
THE MATTHEWS CO., Port Clinton, Ohio, U. S. A.
Quality Service Since 1890

may soon be transmitted via radio telephone as a regular service. Perhaps we shall have radio music and moving pictures aboard!

Ladies will be interested and perhaps disappointed to know that no special dress is required for air travel. With heated cabins, and windows open or shut at the desire of the passengers, travel is no more arduous than in a Pullman. Moreover, there is no coal dust or grime to fear.

Perhaps the most authoritative study of the principles of passenger comfort is that which appears in a report issued by the Daniel Guggenheim Fund. The subsequent considerations of passenger accommodation are based largely on the findings of this report.

European designers seem to prefer two rows of single chairs placed on either side of a central aisle. In the United States, two seats on one side of the aisle and a single seat on the other is considered a good arrangement because it avoids an unduly long cabin, and allows passenger loads to be concentrated. Two seats together may also please friends, and give courage to a timorous couple! Comfortable chairs, preferably with adjustable backs and head rests, are essential. The best remedy for airsickness is sleep; and in general, passengers on long air trips should be able to sleep. Chairs should be strong and rigidly fastened, but have no sharp edges or corners. Spaciousness in the cabin adds to comfort, mental and physical. Everyone seems agreed that none but the lightest parcels should be placed in the cabin. Heavy units of baggage should be preferably placed forward, to prevent the baggage crashing on the passenger in case of an accident.

Lieutenant Monteith, in a paper presented before the American Society of Mechanical Engineers, predicts that the large four-engined plane of the near future will have arrangements similar to those of the best trains, with sleeping compartments, smoking rooms, an observation platform, and conveniences for meals.

European operators are unanimously of the opinion that passengers should not be provided with parachutes, because they are difficult of use, and because few passengers would be able to use them in an emergency. And certainly the pilot should not have a parachute, if the passengers have none. Many plans have been suggested of seats with parachutes attached, of parachutes for the whole plane, et cetera. These suggestions are the subject of much controversy, and no such device has come near to adoption as yet. Regarding safety belts, the general practice is to omit them in cabin planes, although they might be very useful in bumpy weather.

The Bureau of Standards in Washington has done some splendid work in determining the most effective noise insulating material. It has been found that the material should be of a fibrous and resilient character packed as loosely as possible between the inner and outer walls of the cabin. Our diagram on page 407 shows a typical and effective method of packing. The same material and method of packing are also effective in providing heat insulation. Unfortunately, a cabin cannot be completely insulated, because of windows, and even if these are closed they still are poor insulators.

Among the materials employed for noise insulation are sponge rubber; wood-fiber materials such as "dry-zero" blanket; and

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS
MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American
SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.
Books and Information on Patents and Trade-Marks by Request
Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
BERNARD & HELLER LABORATORIES
Labor Saving Machinery Designed & Built
Circular ~ References ~ Guarantee - Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

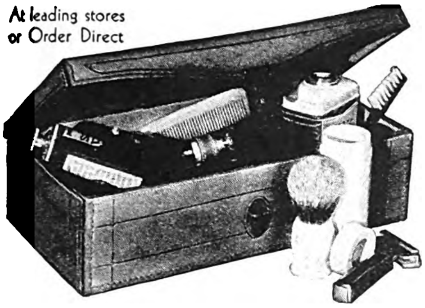
I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

PATENT FOR SALE
ROTARY WELL-DRILLING APPARATUS—U. S. Patent No. 1721004. Device has for its object provision for assuring against lateral swaying or side deflection of the drill bit, causing an oversize bore or crooked hole.
ALBERT S. DEBOSE
2016 E. 105th St., Los Angeles, Calif.

A
Receipt for Every Use
Cyclopedia of Formulas
$5.50
(postpaid domestic)
SCIENTIFIC AMERICAN

At leading stores
or Order Direct



Cows can hardly grow such hides fast enough

...we didn't realize there were so many "solid-leather" fans

It's not easy to get the choice, thick solid leather about which Hamley Kit users are so enthusiastic. But our experience in making famous Hamley Cowboy Saddles has proved that nothing short of this supreme quality will stand up under constant use and hold its shape...and that Hamley leather grows even more beautiful with passing years. Men praise the convenience of Hamley Kits, too—no fussy loops to waste time in packing. Sent postpaid...unconditionally guaranteed. Hamley & Co., 97 Court St., Pendleton, Ore.

Medium	* 8⅝ x 3⅞ x 1⅞	$ 6.00
Large	* 9½ x 4½ x 2¼	7.50
Extra large	* 10½ x 5⅜ x 2¼	10.00

* *Inside measurements. Name or initials embossed on lid, 25c extra.*

HAMLEY KIT

MADE OF GENUINE SOLID LEATHER LIKE A FINE

COWBOY SADDLE

TRY OUR

BOOK SERVICE

SCIENTIFIC AMERICAN

UNIQUE TRADE MARK REG'D. THIN LEAD COLORED PENCILS 24 Colors *Make fine lines in color*

$1.00 per dozen

UNIQUE pencils have even more uses than they have colors. They appeal to everybody who wants to do neat fine work in color . . . such as checking, sketching, underscoring, map coloring, correcting blueprints, proof reading, etc.

UNIQUE leads are as thin as those of a No. 2 VENUS black writing pencil. They can be sharpened to a needle point.

12 Colors (Asst. No. 1116) *per box* $1.00
24 Colors (Asst. No. 1117) " " $2.00

At all dealers or write direct

American Pencil Co., 542 Venus Bldg., Hoboken, N.J.

A VENUS Pencil Factory Product

acoustic felt. A fairly thick plywood with balsa wood core has promise. The use of soundproofing material is advantageous because it serves also as a heat insulator and tends to dampen unpleasant vibration.

While insulated cabins are very much quieter than uninsulated ones, the problem of noise is far from being solved. There are certain inherent factors which make for noise in the airplane. The high-speed propeller has its tips moving nearly at the speed of sound, and is bound to produce noise. Some authorities believe that gearing down the propeller is a remedy, but the gearing itself produces noise. Long exhaust pipes reduce the noise of the exhaust. Mufflers for large engines are so heavy and large as to be prohibitive.

The average man in the street associates airplanes travel with plenty of fresh air rushing in through the windows or past the open cockpit. Yet the best plan for passenger work would be to fly with all windows closed so as to prevent draughts and lessen noise, while providing complete ventilation.

Whatever the outside conditions may be, the temperature of a cabin should not fall below 60 degrees, Fahrenheit. The most common method of heating is to introduce air pre-heated by contact with exhaust pipes. This seems to work quite well, although the system used in the Curtiss *Condor* of steam heating is promising because it eliminates all possibility of the introduction of exhaust gas into the cabin.

Ventilation of cabins is farily satisfactory, although it is still largely a matter of guess work. Strange as it may seem, in the average cabin the air moves from the rear of the cabin to the front. Inlets for heated air should therefore be placed in or near the floor at the rear of the cabin, with ventilators at the top.

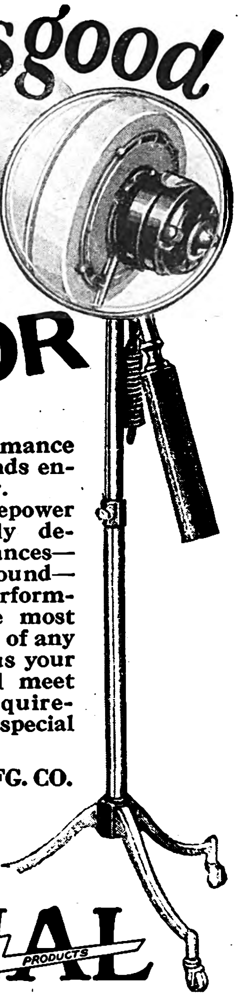
One of the terrors which prospective air passengers seem to dread is airsickness. Some people are sure to be airsick under almost any conditions, just as some people are seasick on the calmest seas. But provided passenger cabins are large and well ventilated, airsickness is little to be feared. Stout Air Service, Inc., a reliable organization, reports that less than 2 percent of the passengers carried in a closed cabin plane between Detroit and Grand Rapids became airsick. Another report states that on the London-Paris Service, under the worst conditions of weather, the percentage of seasick passengers may approximate 100 percent. On European service all the year 'round the percentage of seasick passengers is about 5 percent. It should be less in the United States where there are stronger but steadier winds.

Bumpy weather, nervous tension, poor ventilation, and to some extent, vibration, are the causes of airsickness. An inhaler said to render passengers immune to airsickness is being tried out by the Luft-Hansa, but medicines in general do not seem to be much used.

Complete weather service will probably enable our pilots to dodge localized areas of disturbance. Ventilation will remove danger from close air. Large, stable, speedy machines will suffer less and less from gusts. Night flying may be calmer than day flying. A good place in the cabin is as near the center of gravity as possible. Cleanliness and careful sanitary arrangements help. Experience brings immunity. A good pilot can do much to avoid bumps. On the whole, passengers need not fear airsickness so very much.

(*To be concluded*)

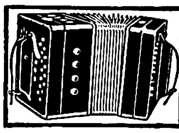
Only as good as its MOTOR



The satisfactory performance of this appliance depends entirely upon the motor. Signal fractional horsepower motors are especially designed for such appliances—induction or series wound—with a guaranteed performance that meets the most exacting requirements of any manufacturer. Send us your specifications — we'll meet your particular requirements, designing a special motor, if necessary.

SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan
Small motor specialists since 1890

SIGNAL MANUFACTURERS OF ELECTRICAL PRODUCTS



The Musical Sensation ·ACCORDEON· Played by Music Rolls

Without any knowledge of Music or Notes, you play in a few minutes, as perfect as an Artist, latest hits, songs and dances. Every instrument guaranteed. Circular No. F and roll list mailed free.

TREASURE SALES CO.
1690 Boston Road New York

ASTRONOMY PHYSICS CHEMISTRY
SCIENCE NEWS-LETTER
BIOLOGY ANCIENT LIFE PSYCHOLOGY

A Vital, Pulsing Weekly

SCIENCE News-Letter is a popular publication filled with *kernels of thoughtful scientific news* and written in a vein that is extremely easy to read. You can spend one half-hour a week with Science News-Letter, *be delightfully entertained* all the while, and finish with a dozen new and intensely interesting germs of thought. The ideas given *will help you in business* and in the general science of living and knowing. Science News-Letter is both relaxing and instructing.

Introductory Offer
$1 for 13 weeks

MEDICINE HEALTH HEREDITY
2107-B St., N. W.
Washington, D. C.
ENGINEERING RADIO AVIATION

Our Choice of Recent Books

General College Chemistry

By Joseph A. Babor, Asst. Prof. Chemistry, College City of New York

MODERN in its approach to fundamental principles and their application, this important text book is of value to all who are more interested in principles than in descriptive details. Atomic structures are introduced at the beginning of the course, and are given prominence throughout the book. Relevant historical incidents and industrial applications are included. A refreshing absence of dogmatism is noted, and the presentation is based on the fact that chemistry is an experimental science, not immune from error. Professor Babor has prepared a teachable text, well planned to assist the student. It is not intended to be a reference book. $3.90 postpaid.

Laboratory Manual In General College Chemistry

By Joseph A. Babor and Alexander Lehrman, College City of New York

THIS laboratory manual is a companion volume to Professor Babor's "General College Chemistry," reviewed above. Quantitative relations are emphasized in the laboratory experiments, and a wide range of experimental material is included to suit the requirements of students in various stages of advancement. The pages are left blank on one side, for notes and records. $2.15 postpaid.

The A. B. C. of Television

By Raymond Francis Yates

HERE are combined a survey of the entire field of television as it is today and the author's idea of the future of the art. In the first chapter is a fanciful description of television of the future. Following this are chapters devoted to the various systems of transmitting and receiving television images, the sending of fascimiles by wire, photo-electric cells, neon lamps, amplifiers for television, scanning systems, synchronization, and last but no means least, two chapters on experimental television which will interest anyone who is experimentally inclined. $3.50 postpaid.

Our Biggest Customer

By George Harrison Phelps

WAGE earners constitute 86 percent of our buying public and these who have made themselves the greatest *producers* have now become the greatest *consumers*. The laboring man has passed from the station of some one to *hire*, to some one to *sell* to. This is the new philosophy which the author deduces in this very keen, analytical study based upon years of association with great executives. Its most fluent style and sagacity of deduction will hold the reader firmly throughout. One of the most thought-producing books we have read in many a day.
$2.15 postpaid.

Sound Motion Pictures

By Harold B. Franklin, Pres., Fox West Coast Theaters

THE infant art of the "talkies" has required a book of this type for some time. In it the author treats in a comprehensive manner the entire situation as it appears in the light of developments in the field of sound recording and reproducing. The two basic systems, sound on film and wax record, are dealt with collaterally and in sufficient detail to give even the layman a sound understanding of the principles involved. To persons actively interested in any branch of motion picture work, be it photography, production, or exhibition, this book will serve as a valuable text. To those whose interest is purely passive, and extends only to the entertainment value, it will prove a source of information that will increase their appreciation of the effects produced by the "talkies."
$3.20 postpaid.

Field Book of the Skies

By Olcott and Putnam

A VALUABLE hand-book for the amateur astronomer with or without a telescope. A well-rounded book, treating the stars both practically and in mythology. There are numerous features, such as a brief review of modern astronomy, but the main one is the discussion of the constellations, one by one, each being taken up respectively for the naked eye, the field glass, and the small telescope (no R.A. or Decl. given, although maps are clear and permit approximation). Proofreading for spelling would improve the book but this is no serious drawback. Size about 4" x 7" x1"; 534 pages; illustrated; attractively produced. $3.65 postpaid.

Research Narratives Vol. III

TALES of Discovery, Invention, and Research by the men whose accomplishment they cite. Short, fascinating accounts of big events in the world of science since April, 1925. Absolutely authoritative and in many cases the only information obtainable about certain subjects. $1.15 postpaid.

A Short History of California

By R. D. Hunt, Dean. Grad. Sch. Univ. So. Calif.
Nellie Van deG. Sanchez

IN succinct form this history reveals the atmosphere of the successive phases from the earliest Spanish pioneers down to the affluence of the present commonwealth, in a manner suitable at once for the student and the general thoughtful reader. Full bibliographical references append each chapter and detailed sketch maps give the Spanish place names, pioneer trails, etc. An interesting scholarly treatment which ostensibly aims to record proven facts with impartiality. A welcome addition to historical literature.
$4.70 postpaid.

Genuine Antique Furniture

By Arthur de Bles

AS a lecturer in all the large museums of the world, the author has had a wide experience in presenting his subject and knows just what to avoid and what to stress. The cultural atmosphere and recreating of the trends of the periods finds a most happy expression. With 200 illustrations and the necessary details for a true recording, this book withal is far from a catalogue of specimens for it carries one along most surprisingly with sustained interest.

$6.25 postpaid.

Questioned Documents

By Albert S. Osborn

EVEN the layman finds fascination in the amazing refinement of procedure by which the expert proves authenticity of documents. This second edition revives and greatly enlarges the authoritative text which for years has been at a high premium second-hand. It develops the subject in splendid orderly detail and carries through in Part II with citations of the facts and the law of questioned documents. A more complete survey of the art it would be difficult to imagine. Three hundred and forty interesting illustrations. Truly the claim that all available knowledge on the subject has been drawn upon, seems to be substantiated. $12.50 postpaid.

Beethoven the Creator

By Romain Rolland

A SYMPATHETIC lifetime study of the dark places and overwhelming splendors which characterized this man of tremendous stature who gave his soul to music. A really noble tribute which will be enjoyed by all to whom music is the ultimate expression of the innermost pulsations of ennoblement, scarcely comprehensible. Interestingly illustrated and typographically excellent. $5.25 postpaid.

Seven Iron Men

By Paul De Kruif

IN the style that made his "Microbe Hunters" one of the most discussed books of its kind, the author tells of the vicissitudes of pioneering which beset the Merritt family in their long search for iron ore and culminated in the discovery of the Missabe Range. A well-told story of rugged manhood.

$3.20 postpaid.

The Fight of the "Firecrest"

By Alain Gerbault

THE record of a lone-hand cruise from east to west across the Atlantic in a 39-foot cruising racer. A tale of indominable persistence and pluck whose equal can scarce be found in nautical lore, sailing from Gibraltar through the Sound to Fort Totten in 101 days and beset by every possible kind of weather and mishap. $1.65 postpaid.

Forty Years with General Electric

By John T. Broderick

PROBABLY nothing that could be written would more fully demonstrate the loyalty of personnel and the interest of each individual in the success of the whole, than does this story of one man's service through epochal years; what he experienced, knew, and learned. One can readily appreciate why General Electric has had such phenomenal success when it is served with such faithfulness by its employees. A well told interesting story. $2.65 postpaid.

Eminent Asians

By J. W. Hall ("Upton Close")

SIX great personalities of the new East—Sun-Yat-Sen, Chinese Patriot; Josef Stalin, Russia's "iron man"; Mahatma Gandhi, Saint and Politician of India; Yam Agata, the Japanese Bismarck; Ito his liberal opponent; and Mustapha Kemal who is westernizing Turkey—all described by this close student of eastern affairs, in brilliant and informative style. An important contribution to the knowledge of world affairs.

$5.20 postpaid.

Mrs. Eddy

By Edwin F. Dakin

TERMED "The Biography of a Virginal Mind" and giving the life story of Mary Baker Glover Eddy as compiled and interpreted by the 29-year-old author, this work appears exhaustive and certainly is most interesting reading, although one may doubt that the author's experience was sufficient to enable him so positively to determine the true significance of all the many and extraordinary aspects of this most influential life. $5.25 postpaid.

Ancient Carpenter's Tools

By Henry C. Mercer, D.Sc.

A MOST commendable and well rounded record of the tools which man has used to provide his shelter; as interesting as it was well worth compiling. One will immediately be impressed by the many examples of tools that still are used which have come down through the ages practically unchanged. 248 illustrations on coated paper, admirably made up and well bound. Particularly appropriate for the industrial library. $5.20 postpaid.

Armature Winding

By Moreton-Roe-Dunlap

AN entirely new presentation of this standard work covering the whole subject in a most lucid and descriptive style with abundant illustrations closely connoting the text. An essential work for every mechanical and reference library. We had this book in hand but a few moments when we found the answer to a question that had been puzzling us.

$2.15 postpaid.

For Sale by **SCIENTIFIC AMERICAN**

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Mechanical Method Claims Granted

REVIEWING the rules or tests involved in considering the patentability of a mechanical method, the Board of Appeals of the Patent Office reversed the examiner and granted Patent Number 1725274 to Leonard W. Hosford and David Davison for a two-cycle internal combustion engine and a method for operating the engine. The examiner had taken exception to the claims, pointing out that the claims contained several references to a piston. The general test of a mechanical method is that it must be capable of conception independently of one specific machine only, although apparatus is necessary to its operation.

The engine is of the two-cycle type, but differs in details of structure and in particular mode of action from the usual engine of this type. Making use of a hollow piston, the method consists of drawing a charge of air into the piston through its up stroke, and injecting fuel at an upward angle adjacent to and in the direction of the piston head through an aperture in the side wall of the piston, on an up stroke of the piston. This compresses the mixture within the piston on the down stroke, by-passing the mixture into the cylinder as the piston reaches the end of its down stroke. The by-passed gases in the cylinder are compressed on the up stroke of the piston, and are then fired.

It was held that this series of steps, stated in proper sequence, constitutes a proper method, and is not dependent on this specific machine, as the preliminary compression may take place in a chamber other than the hollow piston disclosed in the application. In preparing method claims, either chemical or mechanical, it is important that the steps taken should be stated with minimum reference to specific apparatus, although it is presumed that some sort of apparatus must be used.

Joseph Jenks' Petition

INTERESTING because of its literary style as well as the fact that it led to the first patent granted in America for machinery, the petition of Joseph Jenks to the Massachusetts General Court in 1646 is quoted from an article entitled "Colonial Monopolies and Patents," by P. J. Federico, which appeared in a recent issue of the *Journal of the Patent Office Society.*

". . . Whereas the Lord hath been pleased to give me knowledge in making, and erecting of engines of mills to go by water for the speedy dispatch of much work with few men's labor in little time my desire is to improve this talent for the public good and benefit and service of this country: to which end my intention and purpose is (if God permit) to build a mill for making of scythes: and also a new invented sawmill, and divers other engines for making of divers sorts of edge tools; . . . Now your petitioner doth humbly beseech this honored Court that you would please to grant me this privilege—that no other person shall set up or use any such new invention or trade for the space of fourteen years without my licence . . . lest after your petitioner have expended his estate, study, and labor, and have brought things to perfection, another when he seeth it, maketh the like, and so I loose the benefit of that I have studied for many years before; which will tend to my great damage if not my utter undoing."

Later, in 1655, Mr. Jenks was awarded another patent for seven years for improving the scythe by giving greater length and thinness to the blade and thickening the back of the blade to strengthen it. He was the first American brass and iron worker, and made the dies for the early Massachusetts coinage, including the famous pine tree shilling. He also built the first fire engine used in this country, for use in Boston.

Discontinuance Not Abandonment

BECAUSE it was the intention of the manufacturer to resume activity in the production of articles under its trademark, when justified by trade conditions, the mark was not considered abandoned although it had been unused for a period of six years. This decision upheld the title of Rose Brothers Company, of Lancaster, Pennsylvania, to the trademark "Rosemaid," for woman's garments, including underwear and hoisery. The Rosemaid Company, of Gallion, Ohio, had sought registration of the mark to cover goods of the same description.

In commenting on the non-use of the trademark in question, from 1920 to 1926, the Assistant Commissioner said, "The evidence clearly shows that such discontinuance was due to the disruption in trade in ladies' underwear brought about by the change that occurred at that time from the use of cotton goods to the use of silk and rayon for ladies' underwear, and without any intention on the part of the Rose Brothers Company to abandon the use of the trademark on these articles of trade.

"It seems evident from the testimony that it was the intention of said company to resume activity in the sale of these articles under its trademark when justified by trade conditions. There is nothing in the conduct of the company from which any intention to abandon the use of the mark on ladies' underwear may reasonably be inferred."

"Mama" Dolls Patents Infringed

ALTHOUGH slight changes had been incorporated in the manufacture of "Up-to-Date" dolls, the process retained and infringed the essential features of the patented dolls which simulate the sounds made by a baby, according to a decision of the Circuit Court of Appeals for the Second District. The District court had dismissed the infringements suits brought by Voices, Incorporated, against the Uneeda Doll Company. In reversing the lower court's decision, the Circuit Court ruled that the patents held by Voices, Incorporated, were entitled to a liberal range of equivalents and were infringed by the dolls made by the rival company.

Numerous patents were involved in the suit. A patent for dolls having devices installed for simulating the crying sound of a baby was held infringed by the appellees' "Up-to-Date" devices wherein the stamping of the parts was done in a slightly different manner but the apparatus was operated in substantially the same way as the patented structure. Seven claims of a similar patent for dolls were held infringed by the defendants' structures which embodied the essential features of the patent apparatus but varied therefrom in the use of an additional cap member. The court also confirmed the validity of certain patents for dolls, where the patentee employed a frustro-conical bellows, effecting an economy in space, time, labor, and materials over the prior art devices in which cylindrical bellows were used. This arrangement was held to amount to more than a grouping of old elements.

Dr. Eckener Granted Patent

PATENT was awarded on August 14 to Dr. Hugo Eckener, commander of the *Graf Zeppelin*, which was at that time making its 'round-the-world flight, for "an airship comprising a cell filled with a noninflammable carrying gas, another cell filled with inflammable gas, a collapsible cell within said latter cell communicating with said former cell, and means connected with said latter cell for allowing the escape of inflammable gas therefrom."

The patent covers features embodied in the *Graf Zeppelin.* In 1922 the petition was filed in Germany and in the United States. The American patent was granted more than seven years after the application was filed with the Patent Office.

Patent Law Abroad

AT a recent meeting of the Royal Society of Arts, a paper was read by Robert Burrell on the subject, "The Reform of the British Patent System." The question of improving the existing system has been the subject of prolonged debate, and a carefully compiled report on the needed changes has been published by the British Science Guild. The paper presented by Mr. Burrell, which was printed in the August 2 issue of the *Journal of the Royal Society of Arts*, is partially devoted to general observations and partially to a detailed commentary on the report issued by the Science Guild.

In his general observations regarding the shortcomings of his country's patent system, Mr. Burrell stressed the need for considering the impending reforms from the viewpoint of the internationalist, rather than merely from an insular point of view. The differences in British, American, and other codes of patent law lead many inventors and manufacturers into serious trouble, largely on account of lack of familiarity with the various codes in use at the present time.

As an example of the differences encountered, under the United States law it is not necessary that an inventor should lodge his application for protection before publishing his invention to the world, and he is given two years after publication to apply for protection. In many foreign countries, however, patent protection is denied if the invention has been published in any part of the world prior to the date of application. The validity of a British patent is not affected by publication outside the realm. This example illustrates the importance of paying due regard to the existing laws in all countries in which one may be interested in patent protection.

The report on "The Reform of the British Patent System," as issued by the British Science Guild, submits recommendations which may be said to attack four defects in the present system. The various reforms proposed aim to insure:

1. A greater degree of security, both to inventors and the public, against the grant of invalid patents.
2. The extension of the protection of the patent laws to inventions which are at present unpatentable, either because they are not "manufactures" within the meaning of the Statute of Monopolies, or because they are devoid of patentable subject matter, in the sense that they lack inventive ingenuity.
3. A reduction in the cost of patent litigation.
4. The reduction of the existing congestion at the Patent Office and the introduction of facilities ensuring a quicker patent grant than is at present possible.

Much of the discussion which followed the presentation of Mr. Burrell's paper centered about the *Gebrauchsmuster*, or short-term patent system which has been in use in Germany since 1891. This type of patent protection appeals to many inventors who find in the British patent system a class of invention which lacks adequate protection. The class of articles covered by the short-term patent system includes utensils, tools, machine parts having a novel and convenient shape, and machines of known types having a novel layout of compotent parts.

Under the present system the protection of such articles is difficult; if protected under the patent laws they may not have sufficient subject matter to justify the grant of protection, and if protected as designs they are only protected in so far as their external shape and configuration is concerned. Moreover, the success of many articles of this type depends on quick sales, and so much time elapses before the patent is accepted that the protection when eventually obtained is too late. The report of the Science Guild favors the incorporation of the short-term patent system into the British system. The grants would be definitely limited in scope, covering restricted claims, running for a term of protection not to exceed seven years, and could be obtained promptly and cheaply.

Mr. Burrell and others were of the opinion that the German short-term patents were looked upon with disfavor by manufacturers. Those in favor of the *Gebrauchsmuster* pointed out that the number of these short-term patents is growing steadily, very great use of them was being made by German manufacturers, and there was no evidence to show that such patents had been used to obstruct the normal development of inventions of a patentable nature.

Protection Granted Inventor of Potato Chip Degreaser

RULING that the pioneer who perfects an improved product is entitled to protection, the District Court for the Western District of New York recently held that a patented process for degreasing fried potato chips infringes the patented process of Walter O. Snelling for accomplishing the same result. The court ruled that Snelling was the first to improve potato chips, making them more easily preserved and more palatable by extracting either all the absorbed grease or a proper degree of the whole to achieve the result of invention. In its defense, the Dernell Potato Products Company contended that its product is made in the manner described in a patent which removes the major portion of the grease from the product by means of a centrifugal machine.

The plaintiff's patent was not anticipated or limited to the total extraction of grease, according to the decision. Moreover, even though the defendant has a patent it does not avoid infringement when the process impairs, alters, or modifies the function of the plaintiff's process, when the principle of the plaintiff's mode of treatment producing the result is substantially the same.

The Snelling patent, awarded in 1916, has never been used, and the described product has not been marketed. This fact does not deprive him of protection for its discovery, in the opinion of the court, in view of the fact that its operative usefulness is apparent upon inspection of the patent and claims, and skilled workmen would have no difficulty in producing the improved chips upon examining the specification.

"Penn-Allen" Registered as Trademark

ALTHOUGH each of the names used in the term "Penn-Allen" is the name of an individual, the compound word is not such a name and is registerable, according to a recent decision of Assistant Commissioner Moore in *ex parte* Pennsylvania-Dixie Cement Corporation. The mark had been rejected by the examiner on the ground that a registerable mark can not be made by a combination of two unregisterable words. Commissioner Moore said:

"The appellant contends that its mark 'Penn-Allen' does not consist merely in the name of an individual; that while the words Penn and Allen, separately considered, are

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AIRPLANE-WING CONSTRUCTION—In which a plurality of surfaces are spaced from each other in horizontal planes, said surfaces in one plane being staggered relative to surfaces in alternate planes, for increasing the lifting surface. Patent 1721329. Victor C. Bernhardt.

STABILIZING DEVICE FOR AIRCRAFT—Whereby it will be practically impossible for the plane to side-slip, the stabilizer acting to counterbalance any tendency to nose-dive or tail-spin, and minimizes accidents to planes operated by less experienced pilots. Patent 1720576. Philip D. Stead.

HYDROPLANE—So constructed that it will permit the craft to pass over obstructions in the water, such as cakes of ice, logs, rocks, etc., and will lift the craft entirely out of the water when running. Patent 1720167. Claude S. Clifton.

AIRCRAFT —Having mechanism for operating the wings or planes with a motion closely simulating the characteristic wing action of birds, the wing construction employing values that will close on a down stroke and open on an up stroke. Patent 1723914. John Brookbank.

Pertaining to Apparel

INFANT'S SANITARY APRON—Which consists of a piece of flat material for enclosing the body of an infant and preventing a diaper from soiling the infant's clothes, and which permits a change of diapers without removing the entire device. Patent 1721343. Jane H. Hoover.

BATHING GARMENT—Particularly adapted for children, formed so as to safely expose a large part of the body to the sun and air while bathing, with the addition of a sweater may be used in the streets without attracting attention. Patent 1720629. Joseph Dreyfus.

SHOE—Comprising a half-sole, a counter forming the heel and shank and secured to the half sole, forming a shoe of extremely light weight, comfortable to the wearer, and attractive in appearance. Patent 1723883. Frank Parlante.

SHOE—Provided with a cushioning support which gives resilient mounting for the heel bone and the first and fifth heads of the metatarsal bones, hence giving a three point cushioning for the bones, and arch. Patent 1724975. Benjamin J. Silver.

BELT STABILIZER—For preventing the belt and buckle commonly worn by men from raising above the normal position in which it is placed with respect to the trousers, and to prevent sagging of the trousers at the waist line. Patent 1726387. Fabricio de Alba, B.

Chemical Processes

PAPER-COATING COMPOSITION—A composition for rendering paper waterproof and greaseproof which comprises rubber latex, starch in a jelled state, sodium carbonate, a soluble metallic polysulfide, formaldehyde, and sodium silicate, resulting in a coating which will not become tacky. Patent 1723581. Aaron Ruderman.

Designs

Design for a Nail File—Patent 79191. William E. Harris.

Design for a Jewelry-Display Box—Patent 79188. Leo Flier.

Design for a Badge or Similar Article—Patent 79311. Ted L. Staton.

Electrical Devices

Clamping Terminal—Which is comparatively simple, and particularly adapted for use on storage batteries or the like, insuring a positive electrical connection while greatly facilitating connection or disconnection. Patent 1724763. Charles F. Jacobs.

Vernier Tuning Dial—For radio receiving sets, with dials so connected that a direct reading of fractional parts of the divisions of the dial will be possible with accuracy and ease. Patent 1724762. Monroe S. Howard.

Ozonator—In which a maximum amount of oxygen condensing and ozone generating surface is provided, due to closely arranged perforations in the electrodes which cause a plurality of relatively intense corona discharges, and a rapid formation of ozone. Patent 1725661. Hugh V. McPartland.

Renewable Knife-Blade and Cartridge Type Fuse—In which the ends of the fusible element are clamped between a movable partition and a closure cap, and maintained against rotation by lugs projecting laterally from the periphery of the partition. Patent 1725690. Frank L. Young.

Revolving Automatic Electric Time-Switch—Which can be operated by means of a pulley attached to the motor, and controlled by a gear attached to the motor by means of a ratchet connection which makes it easy to adjust. Patent 1726174. Henry O. Brown.

Of Interest to Farmers

Device for Removing Roots—A cultivating machine, more particularly for removing the roots of certain kinds of grass and thistles, and depositing the roots on the surface so that the wind and sun will dry them up. Patent 1723943. Andrew J. Kropp.

Incubator—An egg-supporting device for incubators of the cabinet type, whereby the entire number of eggs in the trays may be tilted simultaneously without necessitating entering the incubator or opening any doors. Patent 1725634. Charles Y. Hake.

Of General Interest

Hair-Waving Device—Consisting of a pair of cooperating wave members having complemental corrugations which will quickly engage the hair for optionally producing water, plain, or marcel waves, the device is comfortable to the user, and easy on the hair. Patent 1723889. Alexander J. Rusak.

Sealing Device for Inflatable Bodies—Which enables the inflation of rubber bladders used in play balls, prevents the escape of the fluid, and is readily releasable to allow of deflation and obviates the use of separate and sundry fasteners. Patent 1723482. Beulah L. Henry.

Curtain Fixture—Including a pair of brackets adapted to receive a curtain rod and which will support an endless cord whereby curtains or portieres may be drawn together or separated. Patent 1723913. Salvino Bono.

Extensible Stepladder and Chair—The height of which when folded is materially increased by the mere act of lifting the same clear of the floor, the device is automatically locked to prevent collapsing. Patent 1723938. Robert H. Ireland.

surnames, yet the combination forms a new entity, a word with no meaning, and with no function except as a trademark for appellant's merchandise; also, that there is nothing in the statute which prohibits the registration of the appellant's mark.

"I have been unable to discover any good reason for refusing to register the mark. The mark is arbitrary, fanciful, and novel, and is not the name of an individual, but functions as a trademark when appropriated to the appellant's merchandise."

The Pennsylvania-Dixie Cement Corporation had pointed out that the Patent Office has registered trademarks consisting of the combination of surnames: special reference was made to the decision in *ex parte* Crew-Levick Company, in which it was stated:

"The words 'Crew-Levick,' while a part of the applicant's name, are not all of it and there is no reason to suppose that they are together the name of anybody, although the separate words may be surnames."

What Constitutes Public Use

CONFUSION persists regarding the line of demarcation between public use of an invention and use for the purpose of experimentation, prior to the filing of an application for a patent. Although public use abroad is not a bar, such use in the United States earlier than two years prior to the date of application is an absolute bar to the grant of a patent—as to that, patent law is very clear. However, as pointed out by Charles W. Rivise in a recent issue of the *Journal of the Patent Office Society*, the courts will in a worthy case allow an inventor a wide latitude in proving that an apparent public use was merely for the purpose of experimentation.

Only by unequivocal and convincing evidence can the use of an invention be explained away as an experimental use, according to Mr. Rivise, who cites as an example the case of Elizabeth *versus* American Nicholson Paving Company when the United States Supreme Court saved a valuable patent for an improved paving from invalidity by holding that an alleged public use in a public highway for a period of seven years was but an experimental use to test the material. Even when a newly invented device is used by only one person, who may have received it from the inventor as a gift, it is considered in public use unless there is an injunction to secrecy or some other restriction or limitation imposed by the inventor. In the eyes of the courts, any use is public which follows a transfer of the device from its inventor to the user, without reserving control over it, or expecting to make a change in it, or some other restriction.

The courts subject to the strictest scrutiny the affidavits and exhibits filed by the protestant as part of his *prima facie* case. Most public use proceedings arise out of interferences in the Patent Office, or else as a part of infringement suits. The Supreme Court has stated that "the temptation in patent cases to resort to the defence of prior use is always great and the parties are therefore held to the most convincing proof, not only of the fact of such use but to its character as well."

Judge Learned Hand went even farther, in the case of Black *versus* Nathan Anklet Supporting Company, in declaring that "the proof must be as absolute as in a criminal conviction."

Lighting Attachment for Cigarettes—Including a reinforcing sleeve fitted to and extending from the cigarette end, and a lighting substance covering the end, for lighting the cigarette without a match or pocket lighter. Patent 1723877. Nicolai Mednikoff and Leo Liberthson.

Bathtub Pad—Having pillow-shaped portions which are designed to be filled with the desired quantity of water so as to provide a yielding surface for supporting the back and head of a person. Patent 1721571. Carl Miller.

Process for Waterproofing Surfaces—Such as concrete floors, basements, roofs, etc., will resist the action of hydrostatic pressure, or dampness, the coating being of a coal tar base, free from the action of caustics and will not injure linoleum when laid thereupon. Patent 1721861. Eugene R. Oden.

Valve for Inflatable Articles—A metal valve which will enable a person to inflate a body or bladder with its covering, by blowing into it, or utilizing a suitable pump, and will securely prevent leakage. Patent 1723855. Beulah L. Henry.

Towel Cabinet—From which a length of clean towel may be drawn at each operation from an accordion-folded pile, and simultaneously with each movement of the towel different advertisements will be displayed. Patent 1720218. Albert L. Jones and Henry C. Ruschmeyer.

Display Rack—Normally disposed in an out of the way position, but capable of being moved to any desirable point to permit rectangular objects carried thereby to be conveniently inspected. Patent 1724806. Leo L. Ryder.

Hand Stamp—In which characters contact with a self-inking pad which will swing to one side by a manual pressure in printing the characters upon a surface, the pad automatically returning to inking position when pressure is released. Patent 1723267. Frederick Childs.

Enlarging Extension for Cameras—An attachment which may be applied to standard commercial cameras, without detracting from their availability for other purposes, to aid in producing photographic copies to scale on either plates, films, or paper. Patent 1724866. Frank Allison.

Oil Can—Embodying a pump to force the oil under pressure from the spout, the device is characterized by a removable discharge tube which facilitates the cleaning of the parts. Patent 1724839. Fred I. Jaden.

Novelty—Which may be placed in show windows to attract attention, or for amusement, comprising a water chamber, partly filled with water, and an air chamber, and means for producing bubbles as the water passes into the air chamber. Patent 1724770. Felix O'Neill.

Table—Having top sections which may be moved to increase or decrease the top area, and provide a working surface of different characters, affording more serviceable means for carrying out culinary operations. Patent 1724811. Louis J. Viehmann.

Window-Sash Fastener—In the form of a bracket for attachment to a window sash and a threaded rod, whereby the cooperating sashes of a window may be fastened in various adjusted positions. Patent 1724216. Joseph Neiser.

Cigarette Case—Constructed with channelled walls and leaf spring pressure means for preventing the cigarettes from moving or falling crosswise when part of the package has been removed for use. Patent 1725654. Alfred G. Langlois.

Window Ventilator—Which may be permanently positioned outside of a window casing, either upper or lower sashes, without interferring with the cleaning of the outside glass or the removal or replacement of screens. Patent 1725688. John Walker.

Safety Pin—Of wire, bent to prevent accidental opening, the point becoming more tightly wedged in closed position in proportion to the increased strain placed upon it, the pin will break before the point becomes accidentally disengaged. Patent 1724477. William O. Harris and Frank C. Kohler.

Hardware and Tools

Wrench—Having the form of a monkey wrench as well as a pipe wrench, with means for adjusting the movable jaw and controlling the same so that it may slip over the angle of a nut in effecting successive grips. Patent 1723960. Luigi Viezzi.

Drafting Instrument—Adapted to be used in conjunction with a T-square or other straightedge, and provided with a plurality of apertures for receiving a pencil point so that it will scribe a line at any predetermined distance. Patent 1721793. Charles E. Rowe.

Fastening Means for Hammers and the Like—Applicable to any tool head and tapered tool handle, for securing the head on the handle, the fastening means being adjustable to permit the retightening of the head in the event of a contraction of the handle. Patent 1716605. Stanley J. Shepard.

Faucet Fitting—of the multiple valve type in which various kinds of water can be discharged from a single nozzle, eliminating the necessity of separate feed pipes through a sink or tub. Patent 1721786. George J. Morris.

Sheet-Metal Radiator Section—Formed of two corrugated sheet metal plates, each having a plurality of passage-forming projections, and grooves, the bottom of the grooves of the two plates being welded together. Patent 1726458. Gunnar R. Tellander.

Heating and Lighting

Air Circulator and Heater—For heating homes either by gas or electricity, the heater being so constructed that it will radiate heat and at the same time circulate fresh air, either with or without the aid of a blower. Patent 1724752. Henry V. Deemar.

Machines and Mechanical Devices

Tamping Machine—For tamping plastic pipe and other tubular objects formed from plastic material, the operating mechanism being so constructed as to eliminate soft areas in the completed article. Patent 1723856. James J. Higdon.

Road Grader—Having a long scraper blade which may be changed by one man from one side of the machine to the other so that it may be adapted to throw dirt on either side of the road. Patent 1723931. Clarence E. Gilbert.

Machine Element—A mechanical movement combining a rotary and tumbling motion to effect a rapid and thorough agitation and mixing of the ingredients in the receptacle, particularly adapted for churns, beverage mixers, and washing machines. Patent 1721796. Daniel C. Taylor.

Measuring Device—Which is adjustable, so that different quantities of material may be measured and two or more different kinds measured at the same time, and the quantities may vary with respect to each other. Patent 1721635. Frank M. Miles.

Steamer and Shrinker for Tubular Fabrics—Including a steam bowl and a steam dome over which the fabric may be drawn, and separate means for supplying steam, the apparatus is adapted for either stretching or shrinking tubular fabrics. Patent 1723939. Maurice M. Kasanof.

Film-Handling Apparatus—For handling strips of motion picture film, whereby the film is shifted by a pair of positively intermeshing sprocket wheels, particularly adapted for handling wet films through a bath or other treating chamber. Patent 1723950. Frank J. Mueller.

Lock Mechanism—In combination with a lighting circuit controlling or switching device, whereby, when an occupant of an apartment or room, leaves the premises without having extinguished the electric lights the locking of the door will extinguish them. Patent 1723956. William H. Schuerman.

Drilling Machine—More particularly a reciprocating drill for cutting hard rock strata, the drill rig having means for retaining the drill stem at any desired height for changing bits, or moving the rig. Patent 1724814. Dewey M. Wolcott.

Power Lawn Mower—In which a novel arrangement of cutting blades permit cutting the grass to a point relatively close to the foremost portion of the mower, and thereby close to fences, trees, and the like. Patent 1724409. Charles W. Ott.

Vending Machine—A coin-controlled vending machine which can not be defrauded, having a rack which may be readily operated to eject a newspaper or other article upon insertion of the proper coin or coins therein. Patent 1724765. Sebastiano Lando.

Tension Bracket for Whip Rollers—Of looms, wherein a swinging support is provided for the roller and spring means arranged in the path of movement of the swinging support so as to limit and yieldingly resist such movement. Patent 1724631. Frederick Winters.

Fruit and Vegetable Sizing and Grading Machine—Having an endless carrier adapted to receive the fruits or vegetables in separate holders and means for releasing the various sizes in succession and direct the same to separate grade receivers. Patent 1725665. Andrew O. Moe.

Truck Hoisting Crane—Using the same motive power for actuating the crane as for propelling the truck, a novel means for moving the counter-weight preventing the crane from overturning the truck, and permitting the use of a standard truck body. Patent 1724411. Elmer C. Pitcher.

Loom—Having shed forming means and filling inserting means, a stationary warp guiding reed, and means operated by the inserting mechanism to sweep the filling inserted toward the fill of the cloth. Patent 1726434. Benjamin D. Hahn.

Apparatus for Exuding Caps—For forming caps for collapsible tubes and the like, and particularly the forming of internally-threaded caps, the operation not only forming the cap but ejecting the same after it has been formed. Patent 1726442. Frank J. Lynch.

Medical and Surgical Devices

Mounting for Artificial Teeth—Which affects in a simple way the rigid locating of an artificial tooth between adjacent teeth, in such manner as to produce a tooth of great strength, and having a porcelain incisal cervical and occlusal portion. Patent 1720880. John K. Bishop.

Medicated Peg—Which may be pressed into a tooth cavity for relieving toothache, is reasonably hard yet readily soluble, adapted to relieve pain, heal wounds, or perform any analagous function as a medicated sanitary device. Patent 1721334. Edward L. Dillman.

Prime Movers and Their Accessories

Internal-Combustion Engine—Of the two-cycle type, in which air alone is utilized as a scavenging medium, and fuel, as rich as desired, is forced into the air and mixed therewith and compressed in the cylinder before firing. Patent 1722201. James H. Crary.

Power Transmission—Which includes a shift bar by means of which the propelling devices may be independently coupled with the source of power for forward or reverse drive, and for transmitting power on opposite sides or ends of the vehicle. Patent 1721359. Leonardo Trento.

Carburetor Construction—Whereby all leaking or flow of gasoline into the carburetor of an internal combustion engine may be stopped, thereby preventing damage in the event of fire, and reducing the chance of a car being stolen. Patent 1719837. Eugene Frisbie.

Internal-Combustion Engine—Having a plurality of cylinders which are oscillated by a revolving crank shaft, with the axis of each cylinder at all times intersecting the axis of its crank pin during the revolution of the shaft. Patent 1719683. Willard C. Baker.

Fuel-Control Device for Internal-Combustion Engines—Whereby the waste of fuel incident to coasting, the vehicle either on level ground or down hill, may be automatically prevented, and with it the excessive exhaust of gases, particularly adapted for trucks, buses, and large vehicles. Patent 1721989. James F. Dixon.

Carburetor—Provided with means for preheating air which is mixed with the fuel before the same is drawn by the suction of the engine through a nozzle commonly provided for that purpose. Patent 1722934. Herbert E. Medley.

Pull rod—Consisting of a single integral main operating pull rod, and an adjusting means interposing the rod and valve, for the efficient and noiseless operation of the valve. Patent 1725672. Richard A. Peglar.

Air Valve—An auxiliary air valve adapted to be connected with the intake manifold between the engine and the throttle valve in the carburetor for admitting air in accordance with the needs of the engine at varying speeds. Patent 1725674. William F. Rosenfield.

Internal-Combustion Engine—Which is of relatively light weight as compared with the power generated, and in which the stroke of the piston is cushioned by compression of air thereby rendering the action smoother than in the ordinary type. Patent 1726047. Dwight J. Stebbins.

Pertaining to Recreation

Game Apparatus—Comprising a two-part rotatable casing of transparent material, with longitudinal partitions to form pockets, and intervening baffle elements, and game elements, such as balls, loosely disposed to be rotated within the casing and drop into the pockets. Patent 1722986. Dennis B. McAlice.

Water Top—A whirlable anchored float capable of supporting heavy loads and especially adapted for use on beaches and in pools to afford amusement for bathers who climb on the float and endeavor to retain their position. Patent 1722523. Omer B. Hunter.

Bowling Pin—A composition pin so constructed that its wearing qualities will be greatly increased, which is shock absorbing and resilient, sufficiently heavy to withstand the shock of the ball, and will produce the desired ring when struck. Patent 1722557. James A. Cherrette.

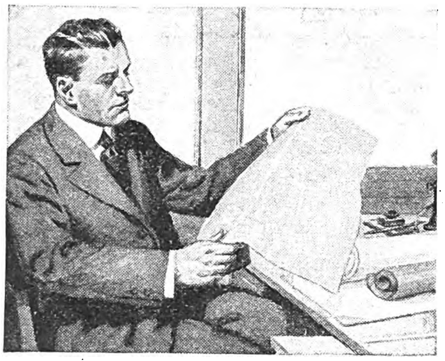
Toy Engine—Exhibiting the characteristics of a steam engine while being electrically driven, the boiler forming a housing for the battery, and the exterior wires simulating steam pipes. Patent 1721447. Thomas S. Haney.

Toy—Which is similar in appearance to the ordinary electric iron, has a novel form of imitation switch and may be secured to any flat surface such as a wall. Patent 1722515. Clarence G. Austin.

Pertaining to Vehicles

Snow-Removing Apparatus—In which heat is used to melt the snow, the apparatus is preferably mounted on a motor truck and will serve to direct jets of steam in the form of a blanket for the melting operation. Patent 1722843. Dominick Fasul.

Reading Architects'
BLUEPRINTS



Learn at Home!

THE building trades are booming. Employers everywhere are looking for men who can read architects' blueprints. Splendid salaries and rapid advancement are offered men who have this special training.

There is an easy, delightful way to learn. The International Correspondence Schools will teach you right at home in an hour a day of the spare time that now goes to waste.

You will like the course because it is so PRACTICAL. You work on actual blueprints—the same blueprints a contractor would use if asked for an estimate, or a foreman would receive from a contractor.

In a surprisingly short time you can acquire a knowledge of blueprints that will be of great value to you in a salary way the rest of your life.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 6112-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, "Who Wins and Why," and tell me how I can qualify for the position, or in the subject, *before* which I have marked an X:

☐ READING ARCHITECTS' BLUEPRINTS

☐ Architect
☐ Architectural Draftsman
☐ Building Foreman
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Electrical Engineer
☐ Electrical Contractor
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Telegraph Engineer
☐ Telephone Work
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Patternmaker
☐ Civil Engineer
☐ Surveying and Mapping
☐ Bridge Engineer
☐ Gas Engine Operating
☐ Automobile Work
☐ Airplane Engines
☐ Plumber and Steam Fitter
☐ Plumbing Inspector
☐ Foreman Plumber
☐ Heating and Ventilation
☐ Sheet-Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration Engineer
☐ R. R. Positions
☐ Highway Engineer
☐ Chemistry
☐ Pharmacy
☐ Mining Engineer
☐ Navigation ☐ Assayer
☐ Iron and Steel Worker
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Agriculture ☐ Fruit Growing
☐ Poultry Farming
☐ Mathematics ☐ Radio

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C.P.A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Common School Subjects
☐ High School Subjects
☐ Illustrating ☐ Cartooning
☐ Lumber Dealer

Name..
Street Address..
City..State......................
Occupation..

If you reside in Canada, send this coupon to the International Correspondence Schools, Canadian, Limited, Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—NOVEMBER, 1929

Allied Radio Corporation 454
American Lead Pencil Co 457
American Medical Association (HYGEIA) 445
American Pipe Bending Machine Co 454
American Telephone & Telegraph Company 451
American Thermo-Ware Company 454
American Tobacco Company Fourth Cover

Francis Bannerman Sons 454
Bernard & Heller 456
Box 193 456
Broderick & Bascom Rope Company 449

Chicago School of Watchmaking 454
Chicago Stock Gear Works 454
Lewis Copeland Company 450

Albert S. Debose 456
Delta Specialty Company 443

Elec. Service & Eng. Bureau (P. O. Box 132) 456
Ethyl Gasoline Corporation 369

Flash Sales Corporation 456
Florsheim Shoe Company 455
Ford Motor Company. (Aviation) 374

General Electric Company 370
Gilson Slide Rule Company 454

Hamley & Company 457
Harper & Brothers 447

International Correspondence Schools 464

Keasbey & Mattison 456

Laboratory Materials Company 454
Los Angeles Chamber of Commerce 372

Masonite Corporation 439
The Matthews Company 456
Metal Cast Products Company 454
Metallic Sign Letter Company 454
Wm. Mogey & Sons, Inc 455
Munn & Co 455 & 456

Pacific Technical University 454
Packard Motor Car Company Third Cover

Red Cross 452
Roat & Lohman 451 & 454

Schwerdtle Stamp Company 454
Science News-Letter 457
Charles A. Scott 456
Signal Electric Mfg. Company 457
Stephenson Laboratory 454

Timken Roller Bearing Company Second Cover
Treasure Sales Company 457

Unisol Mfg. Company 455

Veeder-Root, Inc 453
H. von Schon 454

Western Electric Company 441

Henry Zuhr, Inc 456

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

ALBERT A. HOPKINS
A. P. PECK
ALBERT G. INGALLS
F. D. MCHUGH
LOUIS S. TREADWELL
HENRY W. HOUGH
PROFESSOR HENRY NORRIS RUSSELL
PROFESSOR ALEXANDER KLEMIN

CORRESPONDING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

WALDEMAR KAEMPFFERT, Director Museum of Science and Industry, Chicago.

M. LUCKIESH, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.

W. D. PULESTON, Captain, United States Navy—Technical Adviser on Military Matters.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 5. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

603
SA

Eng'g

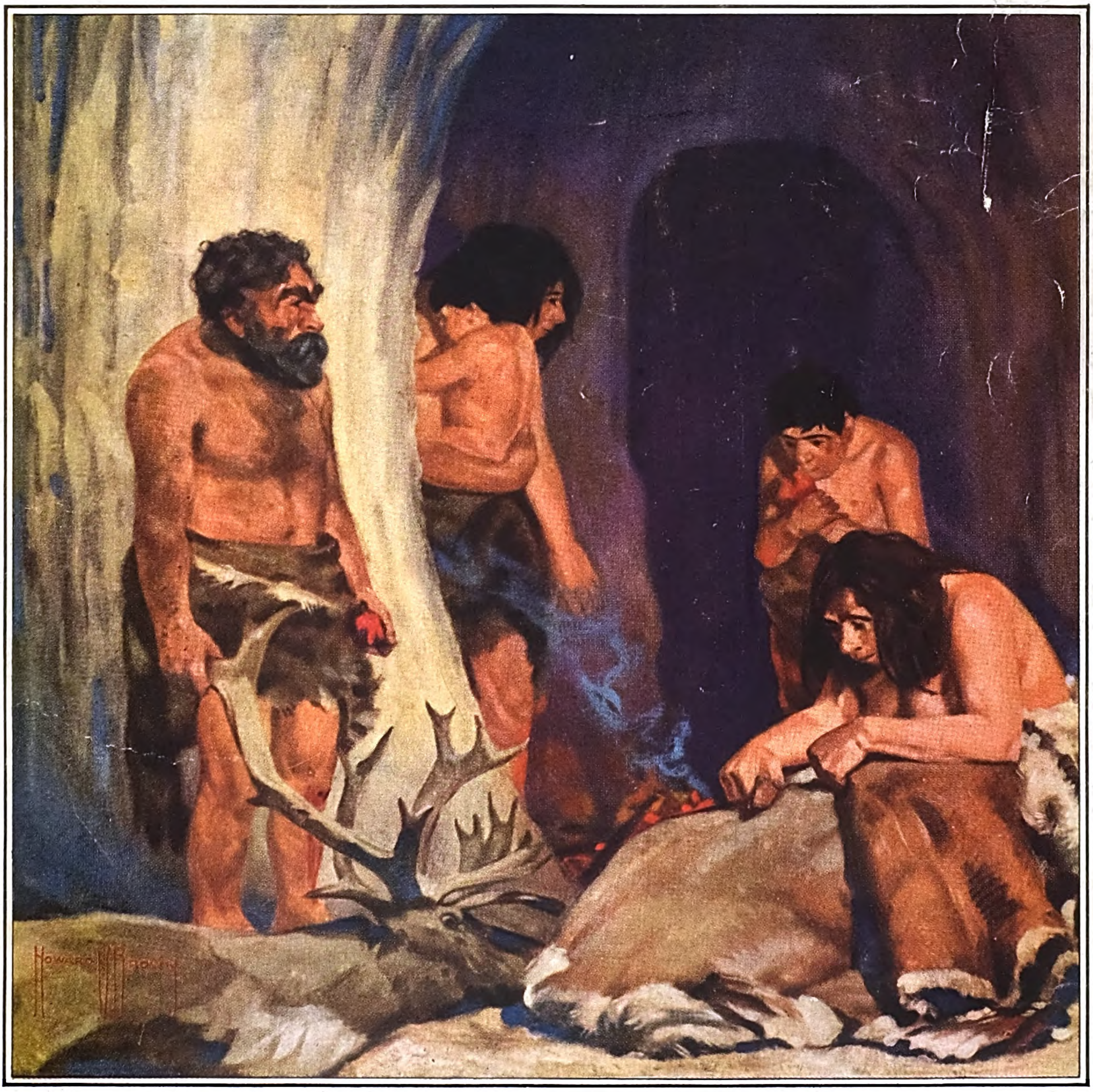
Radio in 1930—Sub-Sea Salvaging—Giant Planes
Ancient Man In Europe—Television

SCIENTIFIC AMERICAN

THE LIBRARY OF THE
NOV 12 1929
UNIVERSITY OF ILLINOIS

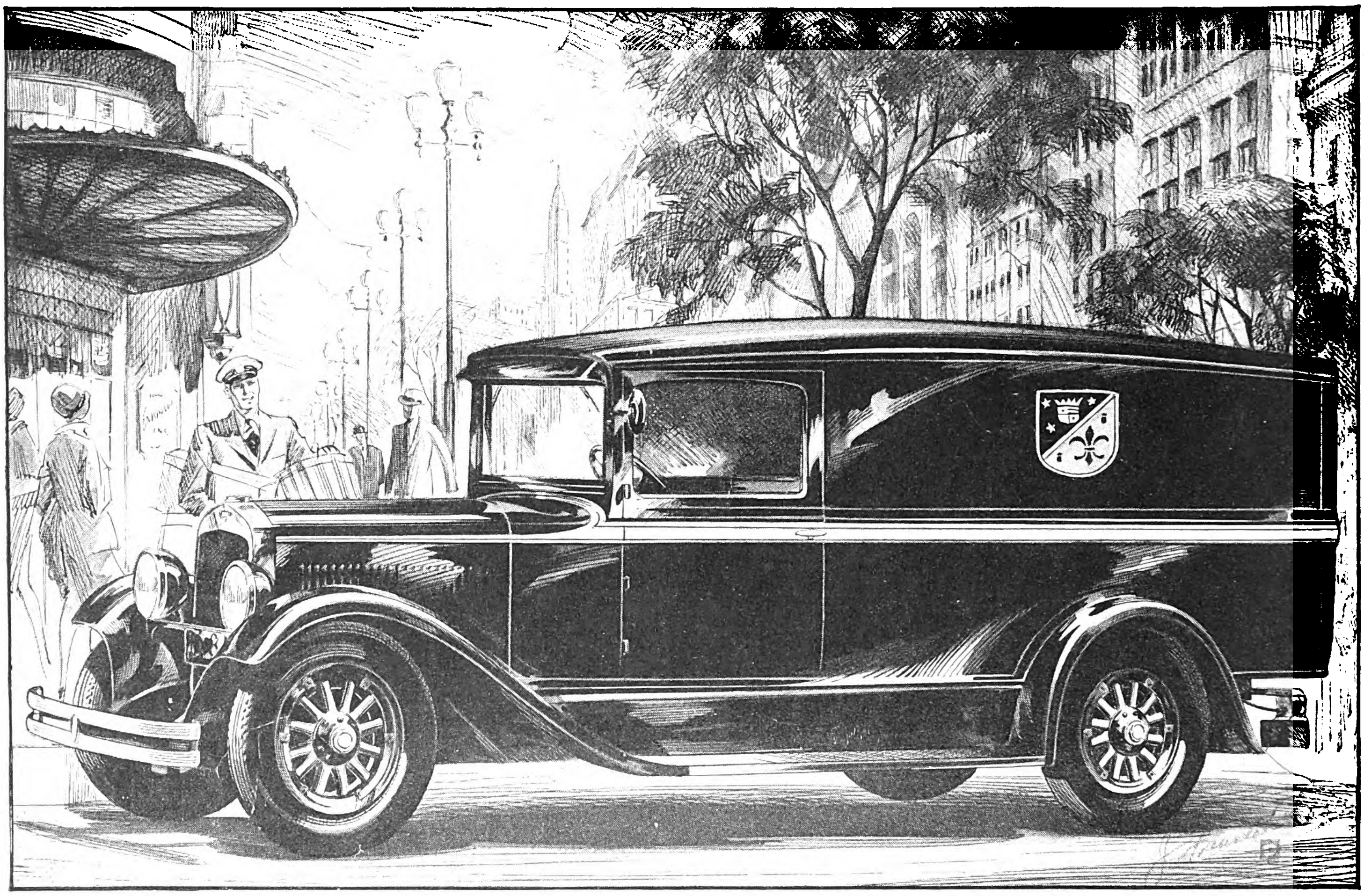
December 1929

35¢ a Copy



Science Restores the Cave Man

$\frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$



LET ENGINEERING FACTS DECIDE YOUR TRUCK CHOICE!

You need never drive a Dodge Truck to prove how good it is. You need never see it, in fact. You can determine the soundness of its design, its advanced construction and its fitness for your needs on the basis of engineering facts alone.

Check the specifications of a Dodge Truck. Give special heed to the motor refinements—those features that so obviously contribute to its economy, smoothness, power, speed, ruggedness and long life.

Consider the axles in terms of metal, bearings and design. Check well the specifications on cooling system, universal joints, transmission and steering gear.

After making a part-by-part analysis of a Dodge Truck you will conclude—as thousands of other mechanically-minded truck buyers have concluded—that there is no need to seek additional proof. The facts disclosed by engineering details tell the true story about Dodge Trucks.

Drive one, too, if you wish—any time, any type. Either way your selection will be a wise one—your investment a profitable one.

½-TON—109″ wheelbase (4-cyl.)	$ 525
¾-TON—124″ wheelbase (4-cyl.)	675
¾-TON—124″ wheelbase (6-cyl.)	775
1-TON—133″ wheelbase (4-cyl.)	745
1-TON—133″ wheelbase (6-cyl.)	845
1-TON—140″ wheelbase (6-cyl.) Heavy Duty	1065
1½-TON—150″ wheelbase (6-cyl.)	1345
1½-TON—165″ wheelbase (6-cyl.)	1415
2-TON—150″ wheelbase (6-cyl.)	1515
2-TON—165″ wheelbase (6-cyl.)	1585
3-TON—135″ wheelbase (6-cyl.)	1745
3-TON—165″ wheelbase (6-cyl.)	1775
3-TON—185″ wheelbase (6-cyl.)	1845

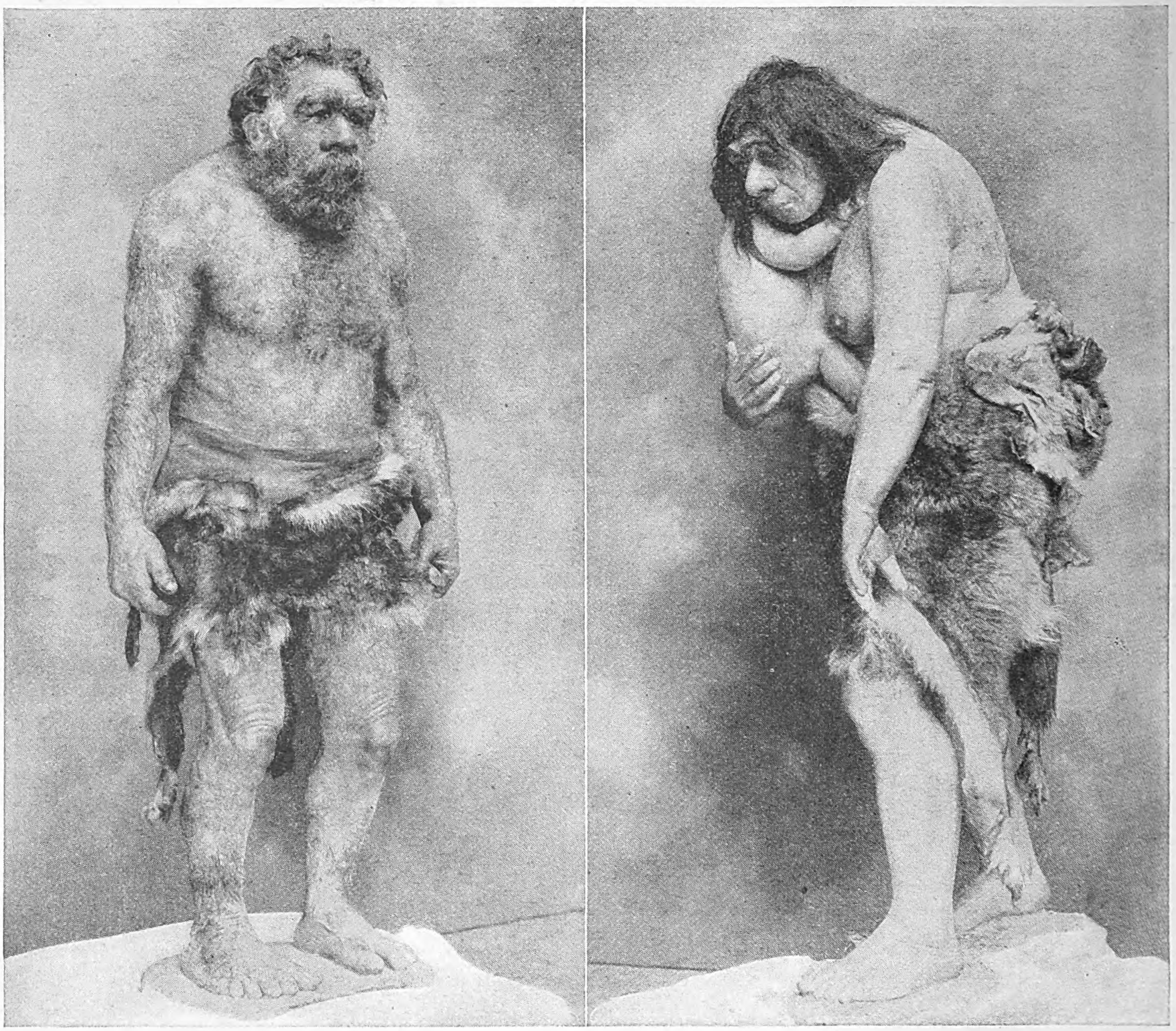
Chassis prices f. o. b. Detroit

DODGE TRUCKS

CHRYSLER MOTORS PRODUCT

C. Leonard Woolley

FOR the last eight years leader of the Joint Expedition of the University of Pennsylvania Museum and the British Museum at Ur of the Chaldees, Mr. Woolley is recognized as one of the world's most famous archeologists. He is a graduate of Oxford University and for over 20 years was director of excavations in Nubia, Italy, and England. The joint work of the two museums named above has proceeded at Ur during a number of years. These have been most profitable years, for an immense number of highly valuable objects and evidences have been unearthed from the windblown and other desert deposits which had sealed them from the elements and from the unscientific searcher down through the centuries since the days of the Sumerians 5000 years ago. One of the most notable and striking pieces of work accomplished was the excavation of the great mound at Ur revealing it as the ancient "Ziggurat," a solid pyramidal mass of brickwork 200 feet by 150 feet in extent and 50 feet in height. According to Mr. Woolley "The Sumerians, the authors of the Ziggurats, came into Mesopotamia from a mountainous country. When they moved down the plains they built artificial mountains of brick where God might have his seat as of old on the holy hills." An article putting forth some of Mr. Woolley's work appears on page 492.



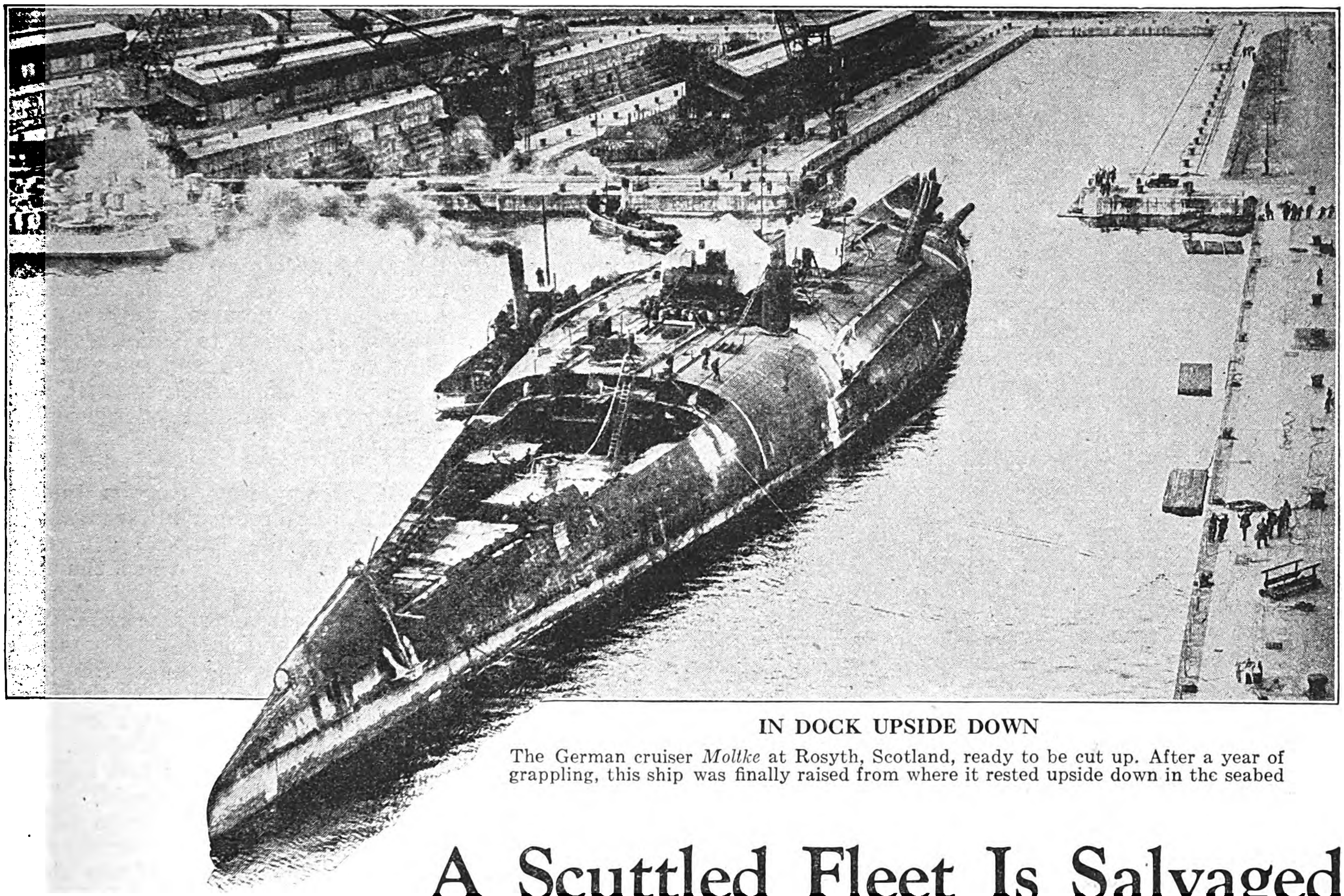
Mousterian Man, Woman, and Infant—a Race That Became Extinct

If you could rub Aladdin's lamp and be transported miraculously to the southern part of Europe as it was 50,000 years ago, you would soon get a glimpse of the Mousterian cave man, or Neandertal man. Perhaps you might stumble on him near the caves whose mouths supplied his habitation. How would he look?

Of this we have no direct information. There are no authentic illustrations of Mousterian man, and he left no drawings of his race on the rock walls of his caves. In reconstructing his physical form, anthropologists have studied more than 20 skeletons, some of them in excellent condition. From these it is possible to derive his posture with accuracy. The bent knees and short thick necks, the large forward inclined heads and chunky bodies, are as scientific as a fact in physics or chemistry, for the shape and angle of the contact surfaces at the joints provide the data, and similar measurable data is provided by other skeletal details.

When, however, we come to supplying the superficial features, we find greater difficulty, because there are no fossils of the fleshy parts. Some anthropologists have given him a fierce, wild aspect. Others have made him appear stupid. There is considerable reason to doubt whether in the main he was either. The evidences of his workmanship in flint show us he was a savage, but not all savages are fierce. These evidences also show that he possessed a fair intelligence; let the reader attempt to fashion even as crude weapons as Mousterian man made and used, and his respect for the "rude cave man" will undergo a rapid rise.

In these two photographs of life-sized reconstructions now on exhibit at the Field Museum of Natural History, in Chicago, and in the cover picture redrawn by our artist from photographs of the same exhibits, we see a new reconstruction of Mousterian man—and woman—made by scientists at that Museum, with the co-operation of several of the world's ablest anthropologists, Sir Arthur Keith and Professor Elliot Smith of London, Professor Boule of Paris and the Abbé Breuil, noted expert. The designer and sculptor was Frederick Blaschke, an American, and the scene is at le Moustier in south-western France. Anthropologists feel that a closer approximation to the real outward appearance of the cave man has here been created than in any previous attempt. Science applauds the effort.



IN DOCK UPSIDE DOWN

The German cruiser *Moltke* at Rosyth, Scotland, ready to be cut up. After a year of grappling, this ship was finally raised from where it rested upside down in the seabed

A Scuttled Fleet Is Salvaged

The Romance of the Difficult Job of Raising the German Fleet From the Bottom of Scapa Flow

By DAVID MASTERS

OF all marine salvage feats, none will compare in magnitude with the raising of the German fleet from the bottom of Scapa Flow. It is the biggest wreck-raising job the world has ever seen, and the most wonderful thing about it is that it is being achieved by a man who, before he went to that lonely lair in the Orkneys, had never raised a ship in his life.

When the Germans sank their fleet, Mr. E. H. Cox knew nothing about salvage. He was busy dealing in metal, and his business acumen had brought him a snug fortune. The world was crying to turn the weapons of war into plowshares, so Mr. Cox bought the obsolete British battleship *Orion* and cut her and her giant guns to pieces in order to throw them into the melting pot. Then he looked round for other scrap, and a big German submarine testing dock passed into his possession. He was about to cut up this dock, when his mind was directed to the mass of metal represented by the sunken German fleet.

Could it be raised? The experts thought not. They were not keen to tackle the task. Cox pondered the matter. He owned a German floating dock that could lift a couple of thousand tons so he decided to try raising the scuttled ships. This man who had never raised a ship, bought 27 of the wrecks. They consisted of 25 torpedo boats and destroyers, the flagship *Hindenburg*, which was resting upright on the bottom and seemed a reasonable proposition, and the *Seydlitz* which lay with her side above the surface like a stranded whale and which did not seem so promising.

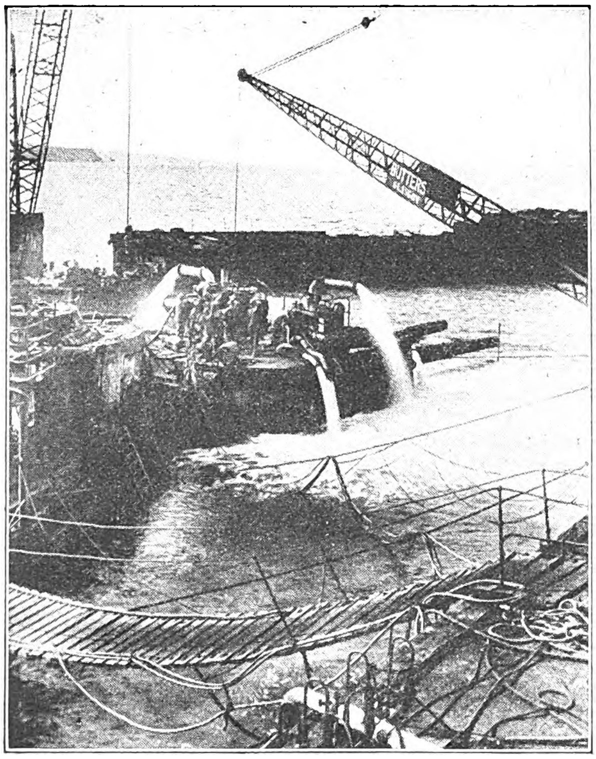
COX towed his floating dock to Scapa Flow and embarked on his sea of difficulties. The experts waited for the trouble to begin. They had not long to wait. Cox cut his floating dock in halves and rigged a series of winches on the edges. He proposed to moor each half of the dock with a destroyer lying between, place hooks through the port holes of a sunken ship, and set men winding her up from the bottom.

An American concern had previously proposed to lift ships by placing hooks through the portholes, and I had already prophesied in my book "The Wonders of Salvage" that the hooks would tear through the plates of the vessel. Cox himself tried one hook and learned his first lesson. It tore through the plating. So he fell back on the proved plan of placing slings right under the keel of the ship and lifting her as in a cradle.

The salvage expert puts his faith in wire ropes. He knows their worth. Cox, however, had the giant anchor chains of the *Orion* in his yard, and he thought that if they were strong enough to hold a battleship they must certainly be strong enough to pick up a little torpedo boat without breaking.

Two men may take the ends of a stick and pull for a life-time without pulling the stick apart, whereas one man could take the same stick in his hands and, by putting his knee in the center, break it easily. Something like this happened to the links of that mighty chain, links so large and heavy that I could barely move one. A pulley wheel acted like a man's knee, and soon links were flying about like shrapnel.

Men shouted, threw themselves face down where they stood, others rushed to the workshops for safety.



WATER IS PUMPED OUT

In an attempt to raise the *Hindenburg*, water was pumped out of her for days. Cox finally let her sink

The flying metal made reports like gunfire, and the destroyer, which had been peeping above the surface, sank quietly down again. Fortunately, by a miracle, not one man was touched by the flying metal.

Then Cox tackled the job in real earnest with wire lifting ropes. His first wreck was raised and beached near his depot in six weeks from the time he started. He set himself to do the work faster. With a wage bill of 2500 dollars a week, each day meant money.

Where other experts had taken perhaps a day to pass one cable under a ship, he originated a plan whereby he passed cables under in the record time of 40 minutes. By slipping a cable under the stern of a ship and winding her up so that only her bow rested on the bottom, he left a gap between her keel and the sea-bed and so made it possible to manipulate the cables in place from the floating dock without sending divers down.

COX cut down the time taken to raise his second ship to 12 days; his third ship he raised and brought home in six days. On occasions he has started work, wound up his ship, and towed her home in three days. This is his record. In the early days when I first went up to inspect the work he had expended over 200,000 dollars on his salvage plant, and all he had got in return were three torpedo boats. He has since raised 25.

If troubles assailed him while he was lifting the torpedo boats, they were as nothing to the difficulties he faced over the *Hindenburg*. He spent a fortune of 150,000 dollars preparing to lift her. For months the divers were busy patching and making her watertight, stopping the portholes and rips with a special cement that hardened in 24 hours, and cutting through pipes and driving plugs into them.

There were 250 patches in the *Hindenburg* when pumping operations began. Day after day the pumps drove out the water and the ship began to stir in her bed. As she began to rise, she showed a tendency to list. To counteract this, Cox drove an old destroyer full of cement hard ashore and sank her. From the masts of the battleship he fixed six-inch steel cables and made them fast to the destroyer ashore, hoping this would prevent the ship from heeling.

His hopes were in vain. As she rose and exerted her pull on the cables, she snapped them like cotton threads. She heeled more and more, but he pumped on, hoping against hope to get her. She was all but afloat, heeling so badly that every moment those around expected her to overturn.

Had Cox sent down a diver to see what was wrong, he might have got his ship. But he was afraid she might overturn while the man was under her, and he would not risk a diver's life. He decided at last to let her fill and sink again. She still rests on the bottom (at the time of writing) waiting to come to grips with the man who swears he will get her.

The disappointment of the *Hindenburg*, which carried to the bottom all Cox had spent on her, would have finished most men. But Cox set his teeth and determined to try to raise the *Moltke*, which was lying quite submerged and practically upside down. A few years ago the greatest experts would have pronounced the feat to be impossible.

Cox grappled with the *Moltke* for a year or more and got her in the end. Then he tackled the *Seydlitz*, and got her, too, after a titanic struggle. In November, 1928, he turned his attention to the overturned battle-ship *Kaiser*, and I rushed north to be in at the death. The tender brought me to the tugs which were ceaselessly pumping air into the upturned battle-ship. Above the surface the air-locks leading into the interior of the wreck stood up like towers.

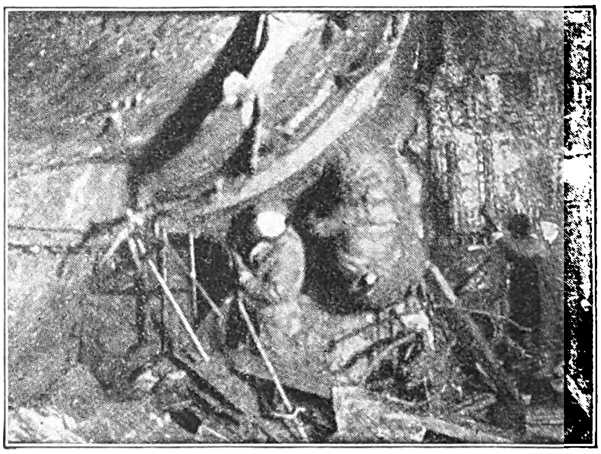
"Would you care to go inside her?" Cox asked. "It will be all right if your heart is sound."

Where other men went to work, I decided to go to watch. I climbed the iron ladder up the side of the air-lock. Mr. Cox struck four heavy blows to tell those within to close the inner door of the lock so that we might enter. A few minutes later the compressed air began to shriek from a valve as it escaped and lowered the pressure inside the lock until it was equal to the pressure of the outer atmosphere.

THE heavy iron door on top of the lock dropped inwards and I went down the ladder. No man could open that door when the lock was full of compressed air. A man swung it upwards into place. A valve was turned, and it seemed that all the locomotives in the world were letting off steam at once, as the compressed air began to shriek its way through the tap into the air-lock.

"Let me know if you feel ill, and we will go out," Mr. Cox said.

I swallowed continually to adjust the pressure inside my ear-drums with the increasing pressure of the air in the lock. Once or twice I felt as though my head were about to burst, but at the proper moment I managed to click open the tubes leading to my ears and adjust the pressures and all was well again. I swallowed hard. I held my nostrils tightly and blew down them to force open the tubes and adjust the pressure on my ear drums. I watched the air pressure dial swing 'round until the whistling and shrieking died away and I knew that the pressure in the lock had been raised to the same pressure as that in the ship.



A TURBINE ROOM UPSIDE DOWN

Flashlight photograph of workmen in the turbine room of an upside-down ship. A turbine hangs overhead

The door in the center of the lock dropped down to disclose a hole leading into the murky depths of the overturned monster. Lighted by electricity there was a fluid black as ink, moving with an oily motion, far below. A little iron ladder tucked out of sight beneath the metal floor was pointed out and I swung on to it and between the inner bottoms of the ship. Everywhere was red rust and oil fuel and coal dust. The mess was appalling. To the touch, everything was filth.

Down one ladder after another I climbed, through holes that had been cut in the plating, and into the stokehold. The furnaces were upside down in front of me, full of red ash that was spilling through the grating on which I stood; a German shovel was wedged upside down in a corner beside a slice and rake; everything upside down.

I MADE my way to the engine room, the floor over my head, the ceiling under my feet. Looking down I saw the lamps which once illuminated the ship. They stood up on what was now the floor. I wrenched one away to serve me as a desk-lamp and a souvenir. Although it had been 10 years at the bottom of the sea, it had only a little water in it, and the electric bulb still lights as though it were right out of the factory.

At the end of an alleyway I saw some oily water and thought that if it were only a foot or so deep, I might wade farther on to explore things. Luckily a question concerning the depth was asked.

"Only 40 feet," came the reply, and I was glad I had not stepped over.

Feeling my way in utter darkness down a passage, I worked along inch by inch with my feet. Detecting a gap ahead, I stretched out farther and found a ledge on which I walked and so came to the refrigerating chamber which was dimly lighted through a small aperture. When a portable lamp was brought, I marvelled how I had made that journey along the passage without slipping into water up to my middle, for I had walked on a couple of small pipes all the way, and the gap was full of water. So does Fate take care of fools.

At an offer to stir up the refrigerating chamber for me, I shook my head. I remembered that men would not work in the refrigerating chamber of a ship which overturned in New York harbor because of the stench.

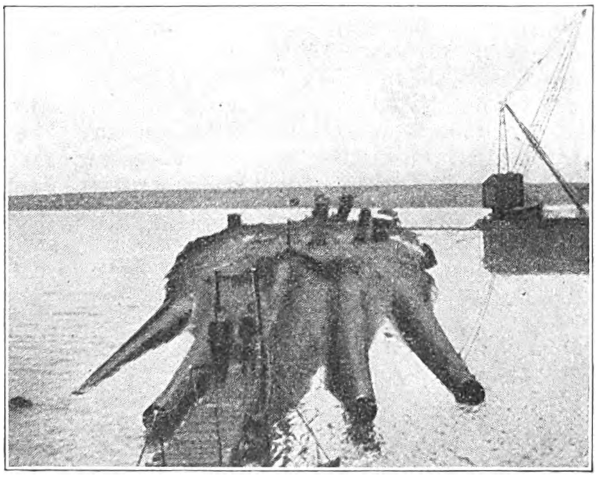
The workman laughed. "You'd want a gas mask," he added.

It seems incredible that this overturned battle-ship of 25,000 tons, sunk in the middle of Scapa Flow, could be controlled and floated by pumping air into her as though she were a pneumatic tire. But since the hull of a battle-ship is built to keep out the sea, it follows that if the ship be upside down on the seabed and all apertures in the hull be stopped, any air pumped into it will be automatically trapped. As it cannot break through the strong steel sides, the air will collect in pockets that will gradually press the water inside the ship downward until, if enough air be pumped in, the ship will become so buoyant that she will float to the surface like an empty bottle.

The grave problem is that of balancing her. Her weights are not evenly distributed; she is heavier aft, where all the machinery is located, than she is forward. If her bow rises, all the air aft will tend to run forward, letting her stern down and pushing her bow still higher. And if the bow rises too high, apertures which have been beyond the reach of the workmen may let the air gush out and you may lose in 10 minutes as much air as you have been able to pump into her in three or four days.

IT is therefore necessary to make all the bulkheads inside the ship quite tight so that air cannot leak out of one compartment into another. Then by regulating the pressure in the various compartments it is possible to balance the ship evenly, bring her to the surface, and tow her home.

It sounds easy, but in actual practice it is most difficult. Battle-ships are a mass of pipes and tubes leading all over the place. One undiscovered pipe leading into another compartment may upset the work of days, for the air may gush through it into a place where it is not wanted and the work will have to be started all over again.



LIKE A GIANT OCTOPUS

A unique view of the battle-ship *Seydlitz*, upside down. What appear to be guns are propeller shaft housings

Unfortunately, Cox had no plan of the *Kaiser*, so his men had to explore and gradually feel their way. For months divers with 30 or 40 men have been working away in the interior of the ship trying to stop all openings leading from one part to another. The bow of the ship is made into one compartment by a cross bulkhead. Two bulkheads running lengthwise divide the middle of the vessel into three compartments, while another cross bulkhead makes another compartment of the stern.

NO PREVIOUS EXPERIENCE

Mr. E. H. Cox standing on the hull of the upturned *Kaiser*, his foot on a patch

Three days before I arrived, the last bulkhead had been made good and an attempt was being made to correct the list of the ship. Some of her top hamper had buckled under her as she turned over in sinking, and she lay with the list of 8½ degrees.

All day long the compressed air shrieked its way through the valve on the higher side of the ship. Cox was allowing the air to escape so that the dead weight of the ship would depress that side, while air was being pumped into the lower side of the ship to raise it and thus correct the list.

FOR hour after hour, Cox stood alone watching the plumb line hanging from one of the air-locks. Chalk marks made periodically on the visible portion of the bottom of the ship immediately below the plumb-bob told him that she was slowly righting.

Once the ship lurched violently during the operations. "It's all right," he said, as men came up from the air-locks in her interior. "She has just slipped off the corner of her conning tower, which was stopping her from coming over."

A diver went down. "She's a foot off all the marks I made this morning," he reported.

"Tomorrow," said Mr. Cox, and the notables of Stromness were with me on the tender when we came to the wreck the next day.

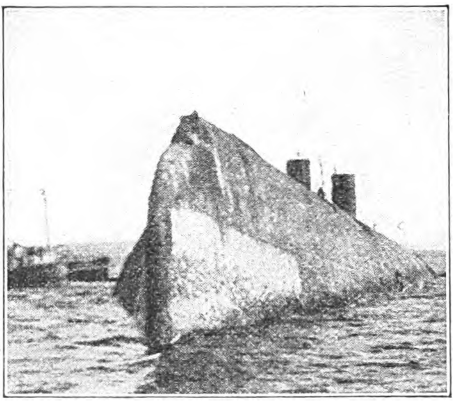
The compressors were driven at full speed. Air poured into the after-end of the ship. The bow was already slightly above the surface. Towards afternoon I began to see air spilling badly from the port side and from the three propeller shaft housings. I guessed she was losing air as fast as it was being pumped in.

Down went a diver and found that one of the torpedo tubes had not been made quite tight, so the attempt was suspended and the men fought to stop the leaks. It was a difficult job, but was finally completed so that when air was once more pumped into her, the *Kaiser* came up from her bed of mud.

The salvage of the huge *Seydlitz* tried Cox sorely. She lay, as I have remarked, on her side, and he determined to lift her in that position. He first stripped from her upper side the belt of about 1800 tons of armor plate. Pumping air into her, he found she was rather unstable. This was not surprising, for as the ship showed a tendency to rise, the turrets and guns resting with their sides on the bottom naturally sought to swing under, turning the ship completely upside down.

COX used his powerful lifting docks to pull in the opposite direction and prevent her from going over; he even fixed half a torpedo boat filled with cement to one side of the ship and used it as a weight to press that side down. He tried other means to stop her, but he could not control the monster. She became so buoyant that one afternoon she swung upside down, snapping the huge nine-inch steel cables along one side of the dock as though they were silk and pulling 12-inch steel bollards out of the side of the dock as though they were tacks. The snapping cables would have cut men in two as easily as a wire cuts cheese, but once more the workers escaped death and injury. New air-locks were then fitted to the bottom of the *Seydlitz*, which was now uppermost, and eventually she was raised and towed to Lyness, where I found her being kept afloat by compressed air.

I underwent the ordeal of going through the air-lock in order to climb down inside the turret practically to the seabed. There was the same infernal shrieking as the pressure was raised, the same efforts on my part to equalize the pressures, and then I went down ladder after ladder and came at last to the turret which had been cut through all the way around.



COMING UP

Bow first, a great battle-ship rises to the surface after being filled with air

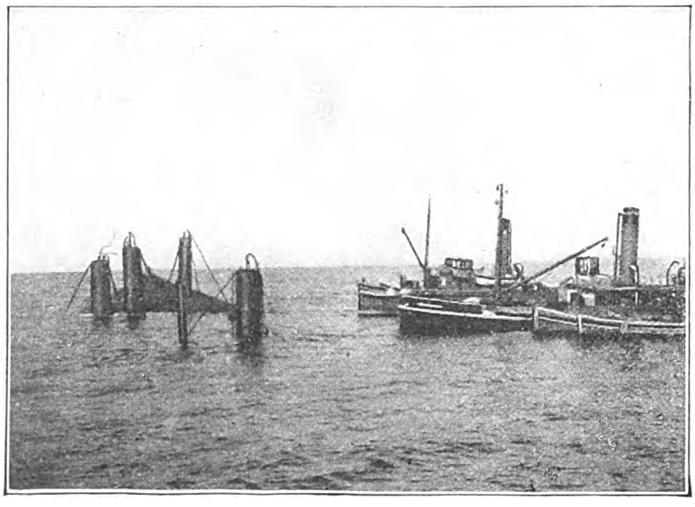
The ship was actually floating about six inches above the turret from which it had been severed by oxy-acetylene torches. That job had taken six weeks and the resultant fumes had been so dense that the workers had to don gas masks; otherwise they would have been overcome.

I crept into the 15-inch space between the outer turret and the inner shell, and washed the filth from my hands and rubber boots in the clear green sea. The seabed was about six feet below me, the surface nearly 50 feet above, yet I could dabble my hands in open water. There were no strong steel plates or plate glass windows to keep it from gushing through that gap. The invisible wall which held it back was just air, the air we breathe, highly compressed. To the sea, the air inside the ship formed an impassable barrier. The salvage wizard had pumped this great ship up from the bottom with air as if she were a balloon instead of a 24,500-ton battle-ship.

The *Seydlitz* inside was a topsy-turvy nightmare. I explored the depths of her down to the turbine room, where the mighty turbines hung above my head supported by a few bolts, and I could not help wondering whether any of the bolts would break away while I stood beneath. In the next compartment the big condenser, from which the tubes had been stolen while she lay on her side, hung under a labyrinth of pipes that twisted and snaked their way higher and higher into the dim recesses above.

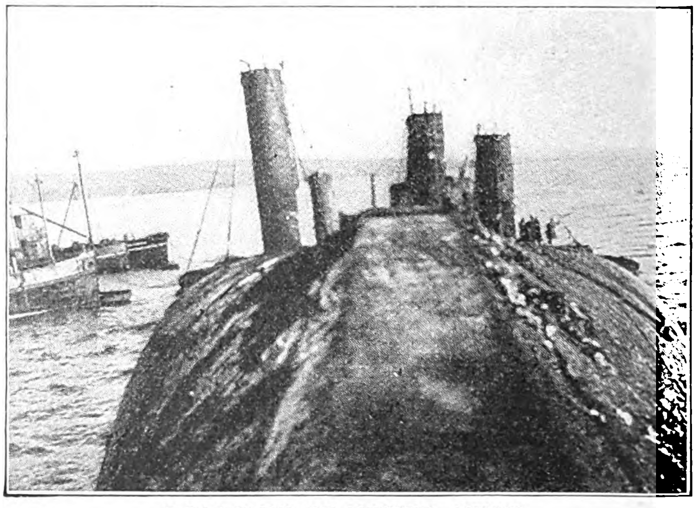
What the ultimate cost of salving the *Kaiser* will work out at remains to be seen, for at the time of writing she still has to make the passage to Lyness, before she can be made ready for the long tow around to the Firth of Forth. And before she can make the passage to Lyness, many obstructions that would foul the bottom of the channel have to be cut away from underneath her. Anyway, I suppose as scrap she must be worth about 350,000 dollars, so she is a prize worth picking up.

Whenever in future I hear that a thing can't be done, I shall remember Mr. Cox who tackled the biggest salvage job in the world without any experience at all. He might have been living in comfort enjoying a large income, but instead he chose to go to the solitudes of Scapa Flow to do a man's job that will become a classic in the history of marine salvage.



AT WORK ON THE "KAISER"

The bow of the *Kaiser* showing her list. The craft to the right busily pump air into her while divers patch any leaks that appear



READY TO BE TOWED AWAY

The *Kaiser* afloat, showing airlocks, which made possible her raising, standing on her bottom. Note size of people amidships

OUR POINT OF VIEW

Lindbergh: Scientist

FLYING over a section of Yucatan, Mexico, which is entirely blank on the maps, Colonel Lindbergh has, according to press reports, discovered from the air and located on the map several hitherto unknown ancient Mayan cities. It is the first time archeological flights have been made in this hemisphere, although Roman ruins have been found in England by the same modern method (See SCIENTIFIC AMERICAN, September 1929).

While some 1200 archeologically important sites in Mexico are known, it is believed that dozens, perhaps hundreds, more are hidden in the densely matted jungle. In the past, gatherers of chicle for chewing gum have accidentally discovered some and their paths have helped scientists to penetrate the jungle in search of others, but a deliberate quest for those in inaccessible regions has been considered rather a hopeless task. An expedition might pass within a few feet of important ruins and be unaware of their existence. From the air, however, the story is different. Columns and masonry stand out clearly and, where overgrown entirely, temple sites and even paved Mayan pathways may be patterned in the coloring or relative growth of trees and plants that cover them.

On one flight it is reported that Colonel Lindbergh and his party, which included Dr. A. V. Kidder of the Carnegie Institution, found four ancient city sites and located them on the maps so that ground expeditions can cut their way directly to them. This flight alone is sufficient to prove the value of the airplane as an aid to archeological discovery. Polar exploration from the air started slowly but, in time, led to Captain Wilkins' antarctic discoveries and to Commander Byrd's great effort; we dare predict a like extensive use of the airplane for exploring the Mayan region.

Clean Iron Workers

"WHITE collar" workers have lamented their lot for years but, from present indications, a new tribe, the "white pants" workers, will always sing the praises of the men who tried out a bit of clothes psychology on them.

There is an indefinable something about neat, clean clothes that exerts an inspiriting influence on all of us. If one is well-groomed, he feels that he is sitting on top of the world; he feels more ambitious and energetic and his work is benefited accordingly; if he is careless and slovenly about his clothes, his work . . . ! Therefore, when a group under one foreman in a plant of the American Rolling Mill Company came to work one fine morning in white trousers and white shirts, other departments followed suit. In this plant there is considerable rivalry between departments to keep down accidents, the one showing the best record winning the plant trophy; and no department was going to let another get ahead of it in anything that might influence that record. The white clothes had the effect of stimulating departmental pride. Floors were kept free of oil and dirt as much as possible and there seemed at once a marked improvement in the work performed. While the idea is still in the experimental stage, it is felt that it cannot but have a beneficial effect on safety and quality of workmanship.

This change is indicative of what is happening in modern steel mills. With the development of the new continuous mills and other innovations, cleanliness has become a reality in an industry that has long been handicapped by working conditions that it was thought could not be improved.

Fatal Accidents

ACCORDING to Dr. Louis I. Dublin, of the Metropolitan Life Insurance Company, the United States has a higher percentage of fatal accidents than any other country in the world. For each 100,000 in population, this country had 78 fatal accidents in 1927 while Scotland had 50, England and Wales 38, Germany 36, Sweden 35, and France 29.

This deplorable state of affairs, instead of being remedied, is growing worse. In 1928, the number was the highest on record. This is partly accounted for by the fact that automobile accident fatalities, numbering 27,500 in 1928, top the list; they are responsible for almost a third of the total. Serious, nonfatal automobile injuries during that year reached the figure of 950,000—or nearly one percent of the country's population! And, strangely, the rural districts are experiencing a more rapid increase in motor fatalities than are the urban centers.

To what factors in our lives may we attribute this alarmingly high rate of death by accident? Our possession of a greater number of automobiles than any other country explains, as indicated above, almost one third of the number but that does not greatly lower our relative percentage over that of other nations. Are we evidencing, in a distressing trait of recklessness, the development of definite racial characteristics? Is it speedmania—or what?

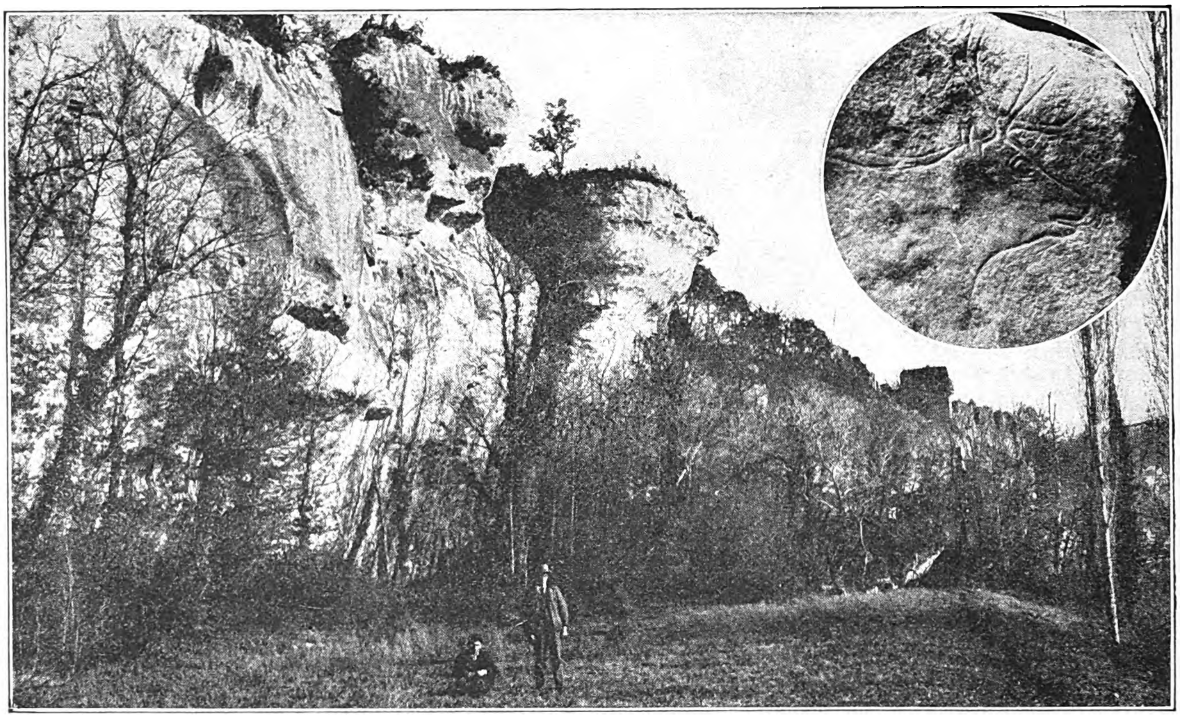
Think it over. "Safety first" as a slogan is out of date. "Safety always" is more to the point. "Take care" that recklessness is not soon labeled with a "made in America" tag!

Fur Farming Misconceptions

WITH the establishment of complete fur farms and of small fur ranches on lands of little value for crops on general farms, the business of raising animals for their pelts is assuming the character of a big industry. Due to the increasing scarcity of certain fur-bearing animals in their wild state, the business may prove important economically in the future. Foxes, fishers, martens, minks, otters, skunks, raccoons, opossums, beavers, muskrats, and rabbits have been studied in captivity and it has been shown that fur can be produced profitably by farming some of these animals; indeed it is now being done on a large scale and as a sideline.

For years a glamorous picture of fur-farming profits has been painted by unscrupulous dealers in fur-animal breeding stock and many people have been deceived. Interested persons have been led to believe that they can fence in a piece of rugged, perhaps worthless, land, turn loose a few animals as breeding stock, feed them a little, and collect annually a sizeable dividend in the form of pelts from the increase in their stock. These people close their eyes, consciously or unconsciously, to the pitfalls in the path of the beginner.

"Successful breeders of fur animals," says Frank G. Ashbrook in "Recommendations to Beginners in Fur Farming," published by the Department of Agriculture, "either must possess or must acquire a clear conception of the important factors involved in breeding. Persons with no experience would do well to obtain employment on a fur farm and thus familiarize themselves with the principles of the business before attempting it themselves." The lure held out by the unscrupulous dealer usually is accompanied by too heavy risks and it is better for the beginner to start with a few pairs of animals and gradually increase the number as knowledge and experience are gained. Like any other business, fur farming can be successful only after much study and more hard work.



LA MADELEINE IN THE VALLEY OF THE VEZERE, DORDOGNE, FRANCE

The cave man did not live in the caves but at their mouths; more often, however, he chose to make his camp at the foot of overhanging cliffs like these—dry, with a sunny exposure. Insert: engraving at La Madeleine

When Reindeer Roamed the Pyrenees—I

A Glimpse of France, "The Capital of the Prehistoric World," In the Days of the Cave Man

By IDA TREAT, Ph.D. (SORBONNE)

Co-author of "Primitive Hearths in the Pyrenees"

CLIMBING the French Pyrenees in August is like climbing any mountain: as you mount higher, you step back over the seasons. Down in the valley, the first apples may be ripening. But overhead in the beechwoods, it is still July; the raspberry patches dear to woodcock and bear, show red with fruit. Where the pines begin, you can find wild strawberries. Higher, rhododendrons blossom among the rocks; and where the snow lies in hollows, if you look carefully you may even discover a belated daffodil.

When you reach the peaks it is winter. Here nothing grows but the hardy *réglisse* and wiry grass burnt yellow from the ice the August sun has melted. This is the last refuge of living things that love cold—sole survivors of the beasts the cave man hunted in the plain below when Europe lay in the grip of the last glacial period and southern France was a desolate tundra with a climate like that of northern Siberia today.

Thousands of years ago the last hairy mammoth disappeared; with him vanished the woolly rhinoceros, the cave-bear, and giant deer. The herds of reindeer followed the retreating ice towards the arctic north. Today only the chamois and the ptarmigan or white partridge remain, exiled to the eternal winter of the mountain-top.

FROM the top of Mont Valier, the highest peak of the Ariège Pyrenees, you look down on the fertile basin of the Garonne river and conclude that *la douce France* has been rightly named. Behind, to the south, lies Spain—arid, rocky slopes, dusty pine woods, and barren foothills. But before you to the north stretches a soft green country: valleys with glistening torrents, heather-covered foot-hills; and beyond, an undulating plain of vineyards, grain-fields, and pastures, extends to the horizon.

From southeast to northwest, a low range of foot-hills cuts the plain obliquely, its green surface broken here and there by patches of gray rock. This is the ridge of the Plantaurel or Little Pyrenees. Deep in its flanks lie many of the great prehistoric caves of France, caves which thousands of years ago served as sanctuary or shelter to nomad hunters of the Old Stone Age. The Plantaurel stands at the heart of the cave country, the underground prehistoric world that reaches out on the north to the gray cliffs and rock-shelters of Dordogne just out of sight beyond the horizon. For 50 years, scientists have explored and excavated the region, piecing together the story of Stone Age civilizations whose traces today lie buried beneath tons of earth and rock or hidden in the deep recesses of the caverns.

Seated today at the foot of a stone cross that marks the summit of Mont Valier, you may find it difficult to picture the country below as it looked when the cave man lived there. In fancy you become a spectator of the mighty panorama of the ages. First you imagine the setting of the panorama; you look down on an arctic landscape, 50,000 years ago, perhaps even earlier. In the place of vineyard and pasture, a vast stretch of steppe and tundra overgrown in summer with harsh grass and stunted bush, and in winter a snowy plain swept by the blizzard. This is the first tableau: the Pyrenees country just before the cave man came there. The caves of the Plantaurel ridge still shelter their original inhabitants: the wolf, the hyena, the lion, and the great cave-bear. Over the plain wander migrating herds: mammoth, rhinoceros, horse, deer, and bison—the first "road-breakers," checked in their westward course by the barrier of the Atlantic and the icy wall of the Pyrenees.

Into the picture come men following the trail of the game; Stone Age hunters, from the unknown land of their origin. Perhaps from farther north where other more primitive races have dwelt for centuries. These, the first human beings to appear in the Pyrenees country, belong to the race of Neandertal. You see them shuffle bent-kneed across the steppe, burly fellows with long ape-like arms and heads that sag curiously between heavy shoulders. Low-browed and dull-witted, they are nevertheless mighty hunters. They drive the savage beasts from their dens in the Plantaurel in the caverns of the rock.

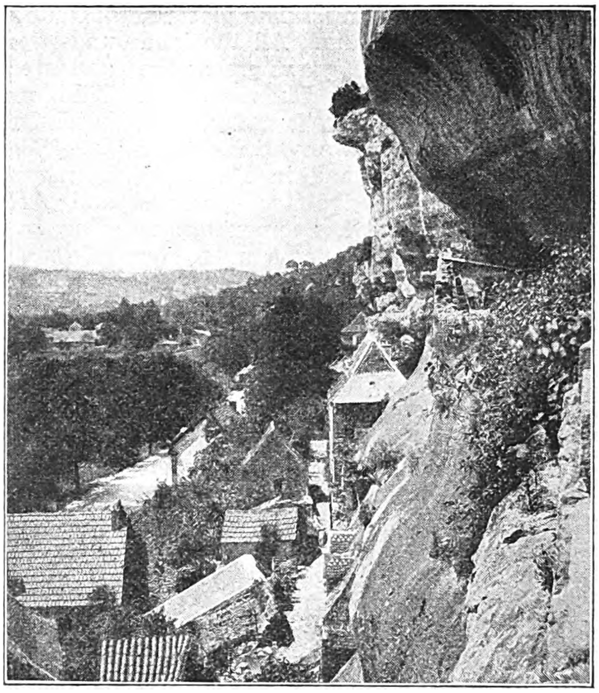
The Neandertals are the first cave men. Seated about the fire at the cave entrance they eat their meals of roast meat, chip crude flint weapons, and scrape and prepare the skins that serve them for clothing. Like the animals that preceded them there they litter the cave-floor with refuse—splintered remnants of their feasts, flint chips, charcoal and ashes. In time, the layer of refuse grows thick and compact. Sometimes, moving on to other campgrounds, they leave behind them in the cave one of their own dead. These men know nothing of art. What religion they may have finds its sole expression in a few vague burial customs. They are hunters and on the steppe there is no lack for game.

Centuries pass; tens, perhaps hundreds, of centuries. The climate is steadily growing colder. Now a new element appears in the picture. Across the horizon come tribes of men on the march towards the west. Perhaps they come from Africa, perhaps from the distant plateaux of Mongolia. A new race. Tall and well-built, they stride erect over the snow. They too wear garments of skins, but carefully cut and sewed. On breast and arms are ornaments, shells and pierced teeth strung on thongs. They carry fine weapons—darts and dart-shooters of carved bone. Their faces are streaked with paint.

These, the men of Cro-Magnon, are the first modern men, modern from a physical point of view, to appear in the Pyrenees region, or in fact in Europe. There is nothing ape-like about them. Their predecessor, the dull-brained man of Neandertal, for all his victory over the beasts, is no match for the newcomer. His race, his civilization, are doomed to disappear. The Cro-Magnons drive him from the country, exterminate him everywhere, and in turn take up their abode in the caves he vacated.

They too are hunters. They track herds of bison and reindeer in the plain, drive wild horses to suicide over the cliffs, and set traps for rhinoceros and mammoth. Clever craftsmen, they manufacture fine tools of chipped flint and carve weapons of ivory and bone. On the cave floor their kitchen refuse lies in a thick new layer above the old hearths of the Neandertals.

But game is no longer so abundant on the steppe, frozen now throughout the year except for a few short months. To secure sufficient food and clothing it no longer suffices to be strong, vigorous, and clever. Nature is hostile to animals and men alike. In his daily struggle with cold and famine, the Cro-Magnon hunter learns to invoke supernatural aid. He develops a cult of fecundity, essential in an inhospitable land where the absence of game means famine and where the existence of the tribe depends on the vitality of its members. In the dark inner galleries of the caves he performs magic rituals. By the light of a torch he carves on the rock walls the symbols of his cult. He resorts to "sympathetic" magic and traces or cuts on the soft stone the outline of the beast he plans to hunt, marking its flank with the dart or arrow which he hopes on the morrow will bring down the desired game.



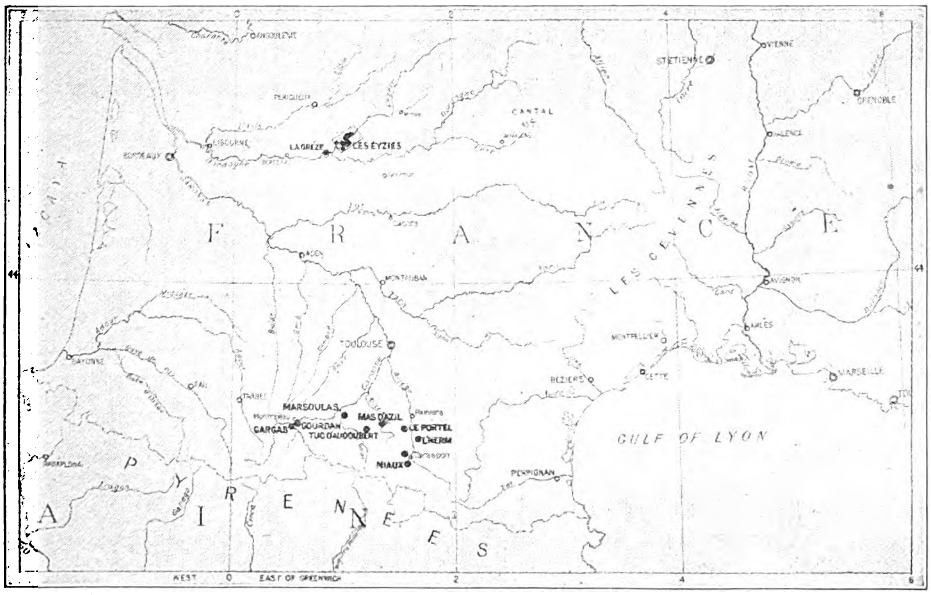
ROCK OF LES EYZIES

Les Eyzies (see map below) is called "The capital of the prehistoric world." It abounds in caves and cave art

And so art is born for the first time in man's history, fully 30,000 years ago. As the years go by, the caves of Dordogne and the Pyrenees become veritable underground galleries filled with hundreds of animal paintings and engravings, the work of the Cro-Magnon cave man, the world's first artist.

Again centuries pass by tens and hundreds. The splendid race degenerates, defeated at last by the unfriendly land. The stature of the Cro-Magnons decreases; they become stunted like the dwarf bushes of the steppe. The old religious cult breaks up into a complicated tangle of magic practices. The noble stylization of the first art forms gives way to exaggerated realism. But the working of flint and bone attains a rare degree of technical perfection.

Again the panorama shifts. Even



Courtesy The American Museum of Natural History

THE TWO MAIN PREHISTORIC REGIONS OF FRANCE

The northern area is referred to as "the Dordogne"; the southern as "the Pyrenees." The caves, under government control, are open without formality to tourists. There are small inexpensive hotels and a visit to the regions will repay the scientifically minded the landscape changes. The glaciers, the snows are melting. All the land runs with water. It grows green; the forest begins to grow. The mammoth has gone; the reindeer is going; deer and wild boar roam the underbrush. In the Plantaurel and in Dordogne the caves are still inhabited—perhaps by a new race that has come from no one knows where. Perhaps too by degenerate peoples of the old Cro-Magnon strain. The present dwellers in the land are Azilians, fisher-folk for the most part, who share none of the cults or rituals of their predecessors. They know nothing of art, beyond tracing geometric signs on pebbles from the river-bed. They are not even clever artisans. The fine technique of working flint and bone has disappeared with their predecessors.

The last civilization of the Old Stone Age is drawing to a close. And the curtain drops on the imaginary panorama as new tribes stream westward over the horizon—peoples of the New Age of Stone, come to plant the first grain fields in the plain below the Pyrenees . . . 10,000 years ago.

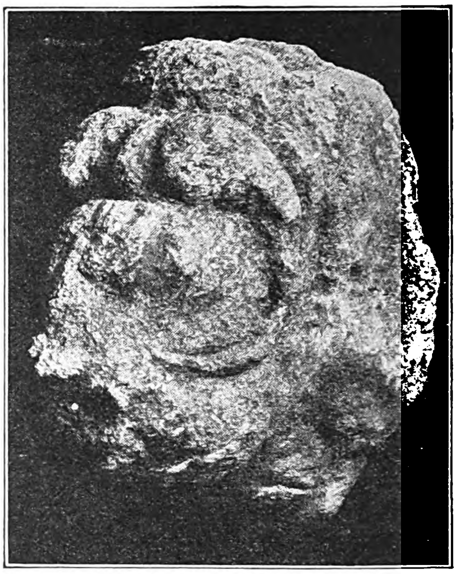
Photograph by Max Begouen

A DIFFICULT PASSAGE

Made easy, however, by a ladder installed in the cave of Tuc d'Audoubert, in Ariège

While the Stone Age cave man undoubtedly chose his rock-dwellings for reasons of convenience rather than scenic beauty, the cave country of Dordogne and the Pyrenees is today one of the most picturesque spots in France. To be sure, the Ariège Pyrenees affords few hotels for tourists and few convenient methods of communication. The modern traveller has generally to supply his own means of getting about, whether by automobile or bicycle; or if not pressed for time he may find it even pleasanter to rely on his own legs.

Quite apart from the prehistoric underworld there is much to charm and interest the traveler above ground. Wild mountain country, pine and beech-forest, trout-stream and cascade, high lakes like mirrors of steel among the peaks that border Spain and Andorra. Slate-roofed villages cling to the mountain-side, and far below are lyric valleys with poplar-bordered streams, velvety pastures, and low red-tiled farm houses. Perched on a rock above the valley stand walls of medieval castles; manor houses lift their peaked towers behind oak groves and clustered orchards. An arched gate recalls the Moorish invasion; a block of sculptured marble reveals the site of a Roman villa or temple.



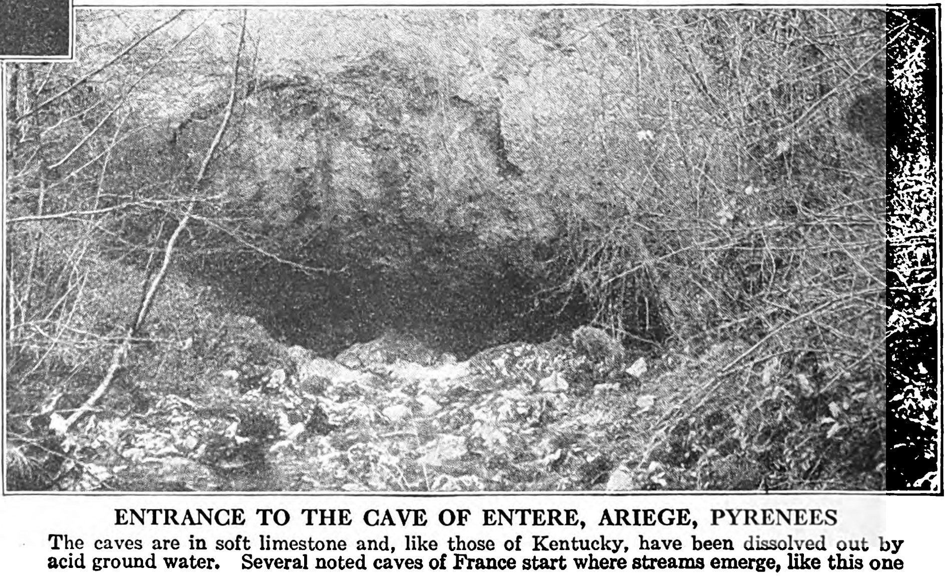
PREHISTORIC SCULPTURE

Head of mountain sheep, Dordogne. The sculptor had nothing but stone tools

DORDOGNE, originally a part of the old province of Gascony, also has castles and manors in a rich setting of green. It is a mellow land of wine and famous cookery; the humblest inn can provide a meal guaranteed to tickle the most jaded palate. Where the Vézère River glides among fields and gardens through a valley bordered by cliffs of gray limestone, you discover with amazement that the troglodyte tradition still persists among the present inhabitants of the region. All along the base of the cliff cling modern houses, houses with only three walls and half a roof; the natural wall of rock supplying the missing portions to the structure. Far overhead, the cliff projects over the valley, so that not a drop of rain falls on the roofs beneath.

When the cave man lived, thousands of years ago, in huts of branches and hides, on the site of these modern dwellings, the top of the cliff must have projected even farther. Great masses of stone have fallen; here and there great blocks lie along the valley floor. The thought that other such blocks might again fall does not seem to disturb the present cliff-dwellers in whom long habit may have developed a peculiar sort of fatalism. A series of horizontal grooves in the gray surface of the cliff—scars left by the roof-trees of houses long since disappeared—shows that the population of the Vézère valley has lived in the shelter of the rock for centuries, perhaps without interruption from the days of the prehistoric cave man.

Grouped about the modern town of Les Eyzies, in a series of little valleys that radiate star-fashion from the main thoroughfare of the Vézère River, lie the famous prehistoric sites of Dordogne. Most of these occupy rock-shelters rather than true caves. Some consist of a single chamber opening in the face of the cliff; others extend along its base in the meager shelter of a projecting ledge. Where the men of Neandertal built their



ENTRANCE TO THE CAVE OF ENTERE, ARIEGE, PYRENEES

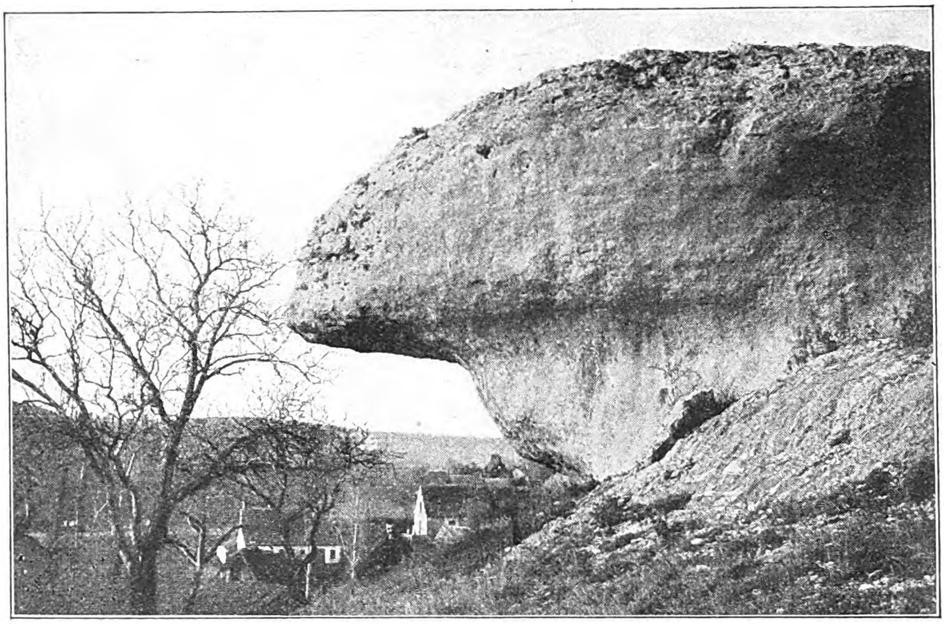
The caves are in soft limestone and, like those of Kentucky, have been dissolved out by acid ground water. Several noted caves of France start where streams emerge, like this one camp-fires the excavator finds beneath a surface layer of debris the most ancient prehistoric hearths of the region: stones blackened and split by heat, bones of rhinoceros, horse, and bear, and quantities of flint instruments and chips. The refuse heaps left by Cro-Magnon man and his descendants hold richer treasure; a great variety of art objects lie in the litter of ashes and animal bones—engravings on stone, bone, and mammoth ivory; and weapons and tools finely carved in reindeer antler and bone.

BARELY a stone's throw from Les Eyzies, two underground "art galleries" pierce the cliff above the Vézère river: the caves of Font de Gaume and Combarelles. The first contains mural paintings of bison, reindeer, and mammoth; the second, an intricate tangle of animal figures cut out by a flint tool on the rock wall. Both caves are shallow, merely a few hundred feet in length, and were known and visited long before scientists realized that they contained specimens of the cave man's art. The proximity of the outer air and the vandalism of early visitors who blackened walls and ceilings with names and dates in candle-smoke have partially obliterated the prehistoric paintings. On the whole these are not nearly so well preserved as those of the Pyrenees caverns in which the cave man's murals are often located a half mile or more from the cave entrance. Nevertheless the animal figures of Font de Gaume and Combarelles rank among the best examples of Old Stone Age art.

The Cro-Magnon artist of Dordogne was also a sculptor. In the rock-shelter of Cap Blanc, excavators uncovered a frieze of horses carved in high relief along the base of the cliff—horses which for sheer beauty of line and form might well be compared with those from the Athenian parthenon. The vault of another shelter bears several delicately sculptured fish; a third yielded curious human figures in bas-relief—one of the rare occasions when the cave artist, who generally limited his work to the extant forms of animals, for possible reasons already suggested, portrayed the men and women of his day.

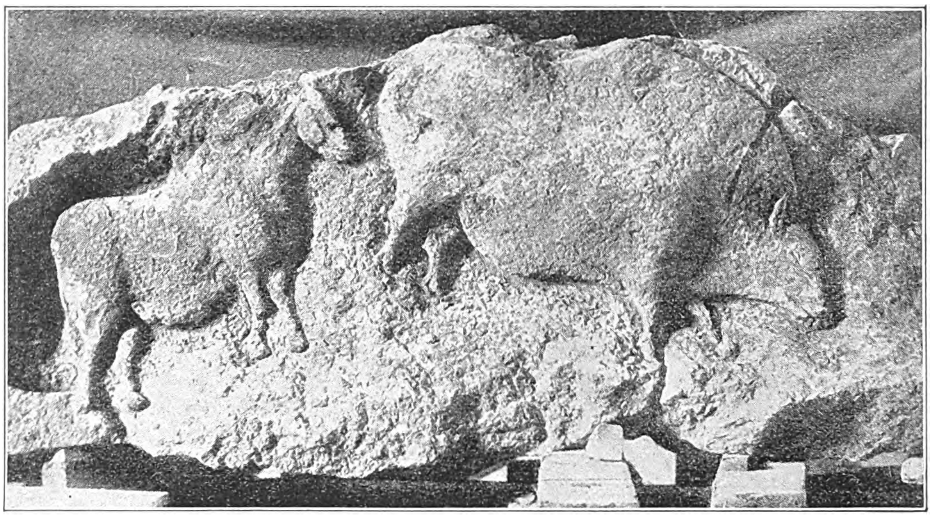
The prehistoric underworld of Dordogne has been more completely excavated than that of the Pyrenees. What excavations are still in progress have been placed under the control of Monsieur Peyrony, Director of the Prehistoric Museum of Les Eyzies, which occupies a partially restored castle that clings to the rock of Les Eyzies, towering high above the little town. (See photograph at the left.)

(To Be Concluded)



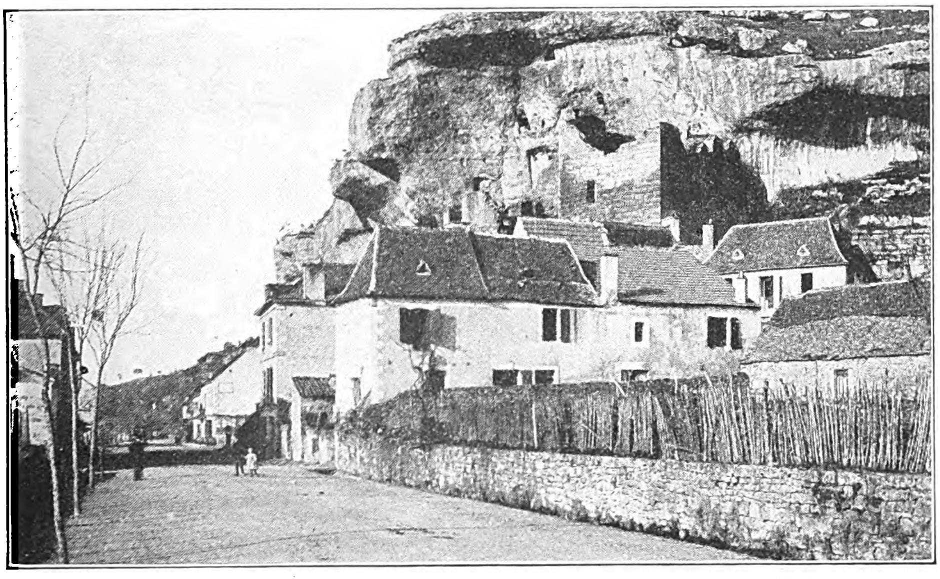
OVERHANGING ROCK SHELTER IN THE DORDOGNE

Various races living in such shelters for thousands of years gradually built up the floor several feet thick with stratified debris, animal bones, and lost or discarded flint implements



ROCK SCULPTURES IN RELIEF, FROM THE CAVES OF FRANCE

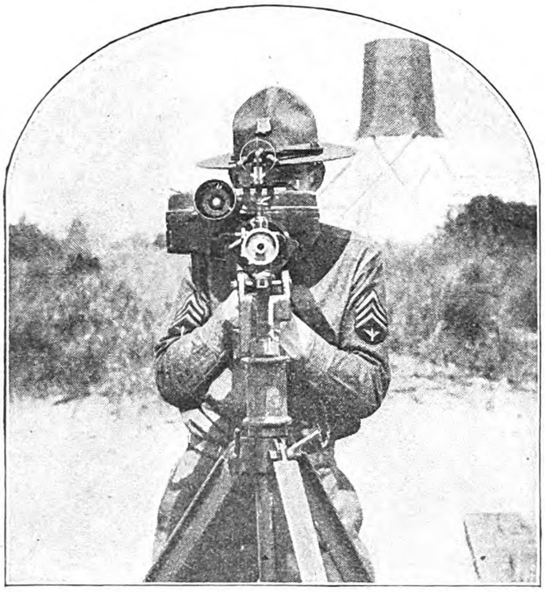
The various types of animals portrayed correspond closely with those which are found in the caves in fossil form. Sometimes they are lacking in perspective, but seldom in posture

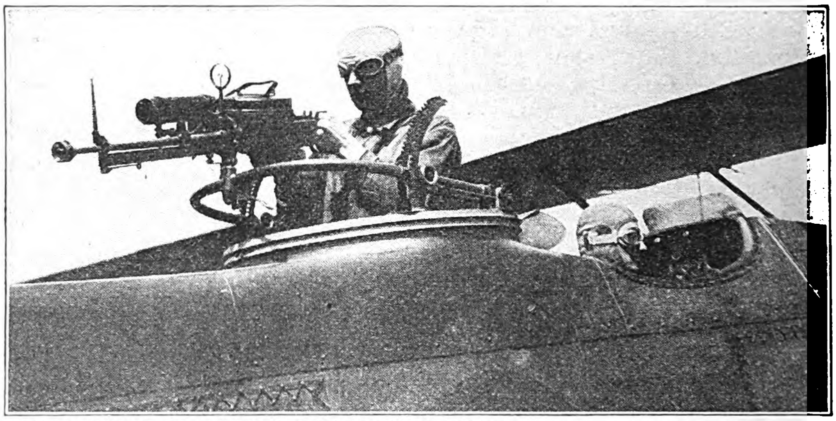


THE ROCK OF LES EYZIES AND PREHISTORIC MUSEUM

Les Eyzies is a hamlet amid scenic surroundings. It has two clean little country hotels and the scientific visitor may to advantage spend a few days there visiting a score of caves

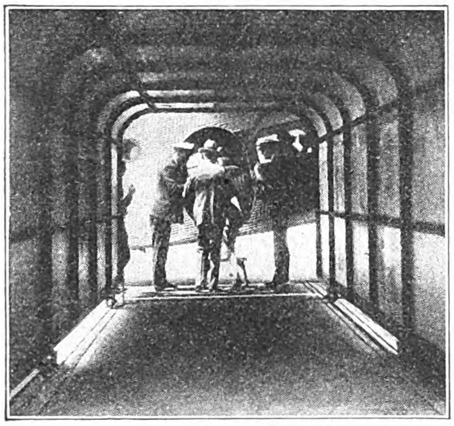
From the Scrap-book of Science





NOT AS DEADLY AS IT LOOKS: A "MOVIE" MACHINE GUN

During recent army maneuvers in which a Blue army and a Red army—composed of Regulars, National Guardsmen, and Reserves—were pitted against each other, a great deal of the mimic warfare was staged in the air. In many of the air fights, this new "gun-camera" was used. It is mounted on a machine gun but shoots pictures instead of bullets. When the plane returns to the ground, the pictures are developed and the number of "hits" recorded

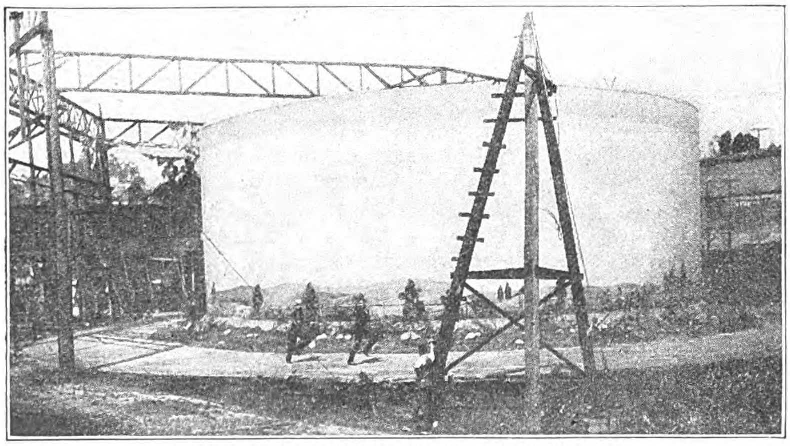


◄ AVIATION CONVENIENCE

Passengers are here using the new movable "canopy" runway which has been installed at the Grand Central Air Terminal in Glendale, California. It operates on a track and can be extended to plane to protect passengers

U-V RAY EFFECT ►

The Health Commissioner of Chicago is testing this device which shows effect of ultra-violet rays on the skin. A 12-holed metal plate is attached to the arm and a hole is closed by shutter each five minutes

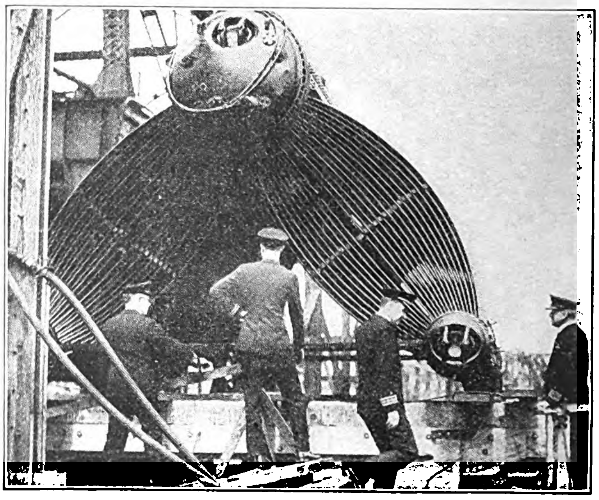


▲ IN A HURRY BUT GETTING NOWHERE

One man chases another on the huge cyclorama, 321 feet in circumference, at the Mack Sennett motion picture studio. The platform on which the men are running travels to the left while the painted scenery in the center travels to the right but more slowly. In this manner a constant change of artificial scenery is produced

THE NAVY PERFORMS A FEAT ►

All the resourcefulness of the Bremerton Navy Yard's staff of engineers was called into play when the first of eight boilers, each weighing 70,000 pounds, was lowered into the partly completed hull of the cruiser *Louisville.* The yard's two 40,000-ton cranes did the job but had to be locked to their tracks. Rear Admiral H. J. Ziegemeir, Commandant of the yard, supervised the work

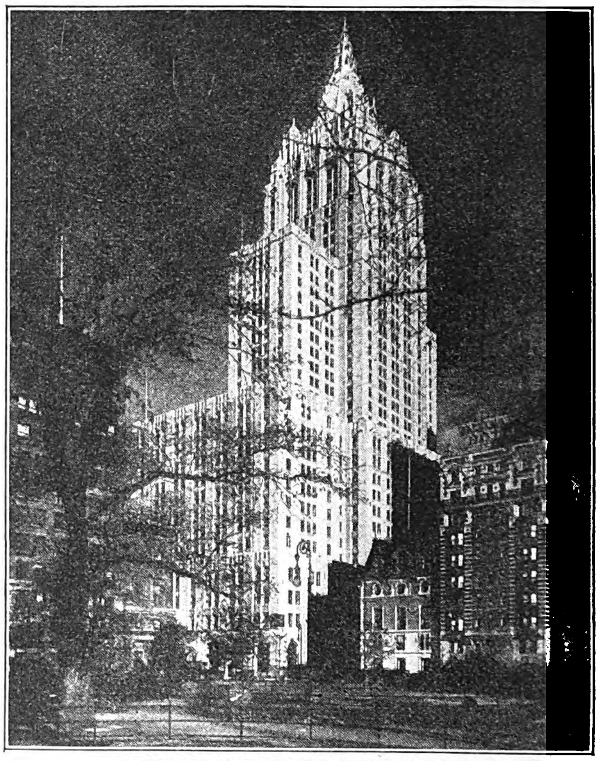


An Office Building of the New Era

Science Contributes to Efficiency, Employee Comfort, and Convenience in a New York "Sky-scraper"

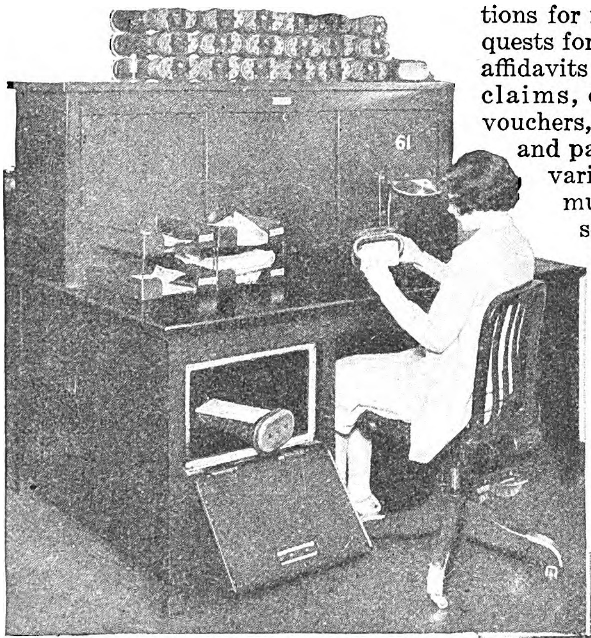
By STRATFORD CORBETT

PROBABLY no block in New York City has been the scene of more notable events or has been visited by more celebrities than that bounded by Madison and Fourth Avenues, 26th and 27th Streets. Once occupied by the depot of the New York and Harlem Railroad, this plot later became the site of Madison Square Garden which has literally been the arena where some of the most colorful spectacles of a generation have been staged.



NEW YORK LIFE BUILDING

The insurance company building on the site of old Madison Square Garden, as seen from Madison Square



DESK TUBE STATION

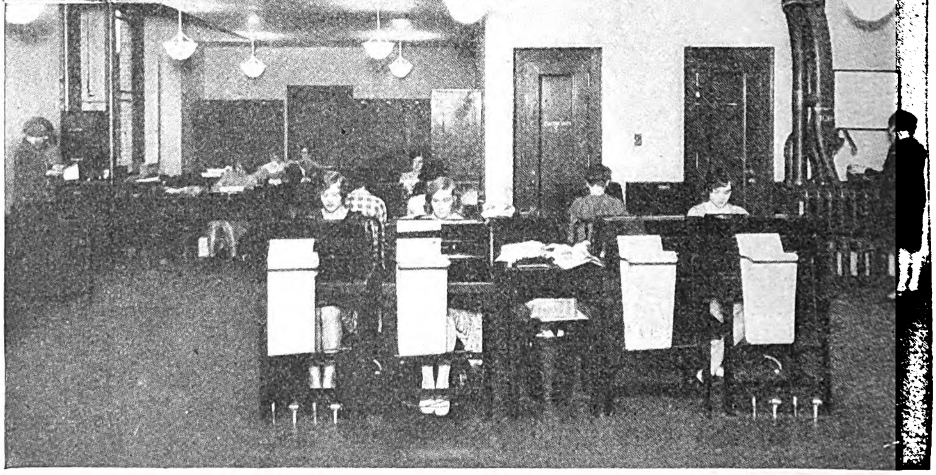
Carriers arrive in drawer at left and are dispatched from desk-top inlet at right

Now, upon this famous site has been erected a new monument to the builder's art: the home office of the New York Life Insurance Company. As majestic in architecture as an old-world cathedral, this new building rises in a series of set-backs and terraces 34 stories to an elaborate pyramidal tower, or spire, the tip of which is some 617 feet above the street level. There are also five stories underground. Many critics and writers have commented upon the beauty of this building, and it was only recently that the Fifth Avenue Association awarded it first prize as the finest structure erected last year in the Fifth Avenue district; yet, impressive as is the building's beauty, still more impressive are the mechanical and scientific improvements to be found inside.

Here, in this great work-shop where are kept the records of more than 7,000,000,000 dollars of the world's insurance, have been embodied refinements which enable the company to attain an efficiency of operation and economy of motion that is little short of amazing. The system used in transferring inter-departmental and other documents is a good example in point.

It is understood, of course, that the routine of an insurance home office consists largely in passing upon, and producing, a vast quantity of paper forms. There are applications for new insurance, requests for loans on policies, affidavits regarding policy claims, dividend cards, vouchers, correspondence, and papers of an infinite variety, all of which must pass through a series of home-office departments for clerical, or special attention. The New York Life estimates that it has on file at the present time approximately 75,000,000 items of this sort.

Naturally, to transfer any number of these important documents from one department to another would, under ordinary conditions, require a large staff of messengers, and would consume a great deal of time. In their new building, the company has boldly solved this problem by the installation of an elaborate pneumatic tube system, said to be the largest of its kind in existence. More



THREE UNUSUAL MEANS OF COMMUNICATION

In the center are teletype machines, used to "telegraph" typed messages to other departments. At right is a tube station, while at left is a dumb-waiter running to a department above than 43,000 feet of oval-shaped brass tubing, four by seven inches in cross-section, reach upward and outward through the quarters of the company like the nerves of some great giant.

Every department in the home office has one or more of the tube stations. From these stations, large leather carriers, each with a capacity of dozens of papers of ordinary business size, are shot at 30 feet per second through independent lines of tubing to a central station in the third basement.

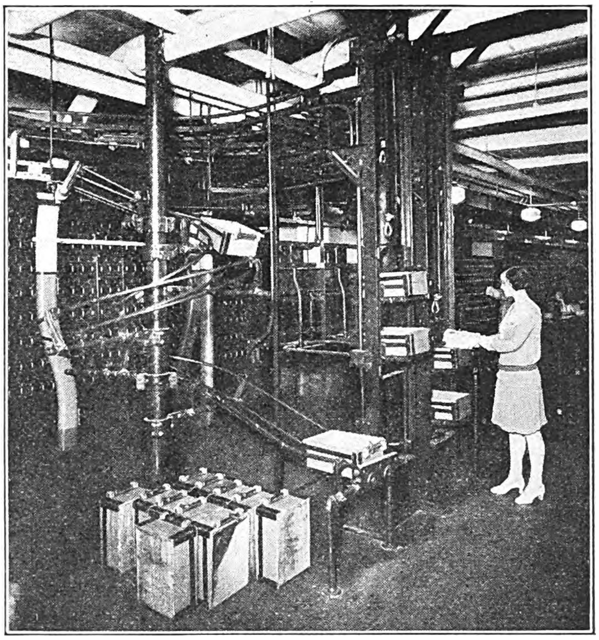
This basement station is a truly remarkable place, seeming, with its long rows of twisting tubes, and slides, and chutes, more like a scene from a futuristic "movie" than an actual reality of the present.

As they reach this station, the carriers drop automatically upon a series of endless belts which carry them immediately to receiving chutes at one end of the room. Here they are sorted by hand and sent by means of another series of belt conveyors to the correct bank of dispatch tubes. At the dispatch tubes stand operators who send the carriers to their proper destinations.

The air for the system, incidentally, is supplied by two compressors (located in a room adjoining the central station) each operated by a 75 horsepower motor, and each having a capacity of 13,000 cubic feet of air per minute at a pressure of three quarters of a pound to the square inch.

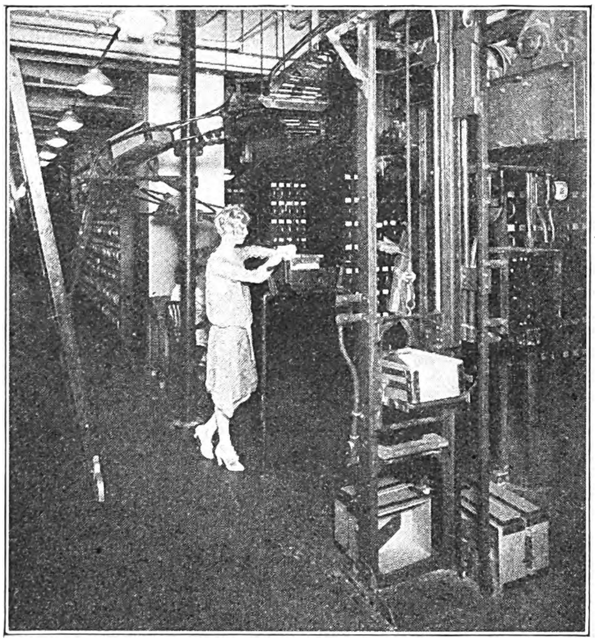
At present the company has in operation 102 out-stations—54 receiving and 48 dispatching stations. Ultimately there will be in use nearly 140 stations. Some of the out-stations, of course, are more elaborate than others. Thus, in the File Division there are, grouped together, six receiving and three dispatching stations, arranged so that the incoming lines discharge upon a long receiving table, while the dispatching tubes are set in a table especially designed for outgoing papers. The mail room, which receives large quantities of outgoing mail each day, is provided with six receiving terminals opening upon a receiving slide, and three dispatching inlets.

In addition to the main pneumatic tube system, there are two supplementary lines directly connecting the security vaults of the company with the treasury and mortgage loan departments. The carriers for these lines are equipped with locks and keys.



SENDING

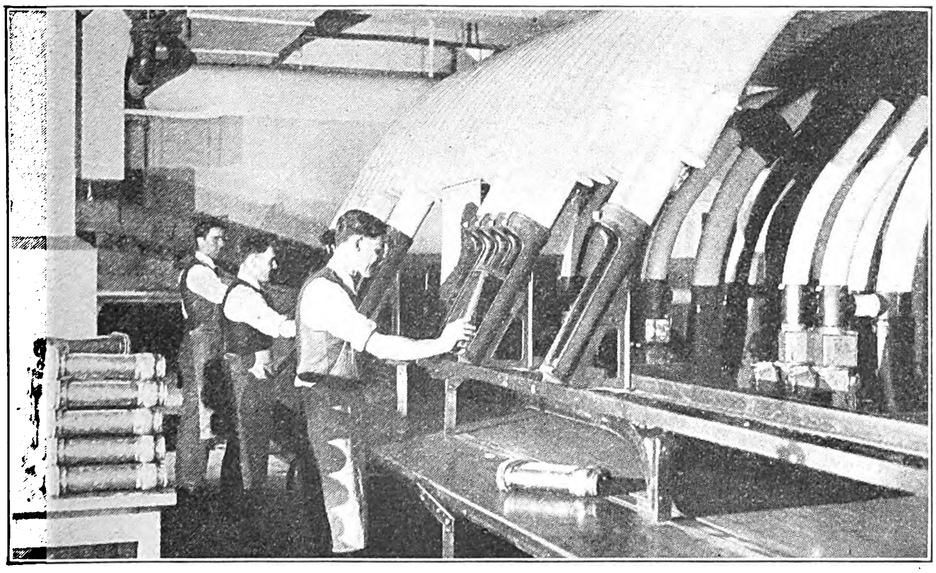
Dispatching and receiving station of special carrier system used in file division where 8,000,000 applications are kept



RECEIVING

Carrier arriving from station above. The system employed here combines electric hoist, endless belt, and gravity chute

Altogether, the company dispatches in a normal working day from 7000 to 10,000 carriers, although at practically no place in the building, with the exception of the central station, the out-stations, and one room in the basement, are there to be found any outward evidences of the tubes themselves. Not only are the tubes effectively concealed, but wherever there is any possibility of hearing the passage of the carriers, the tubes are also soundproofed.

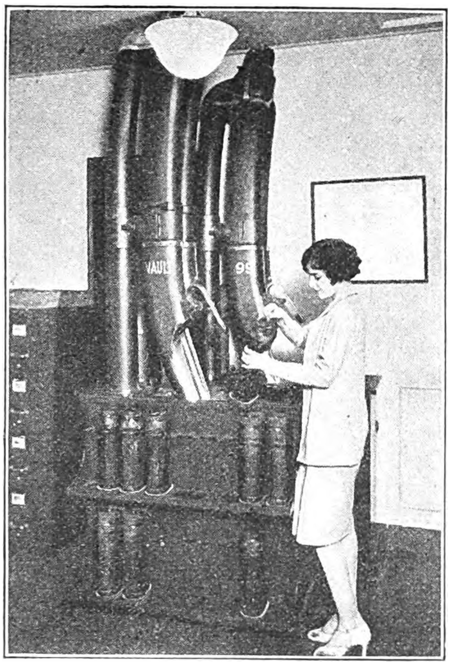


SECTION OF CENTRAL TUBE STATION

One bank of dispatch tubes in the terminal room of the pneumatic tube system where from 7000 to 10,000 carriers a day are received and re-routed to their proper destination

This sound-proofing treatment of the building is in itself most unusual, and certainly a distinct advance in modern building practice. Imagine, if you can, a large office with typewriters and adding machines clicking away, telephones ringing, filing cabinets being opened and closed, doors shutting, clerks coming and going—but with not a sound above a murmur reaching the ears. Even the sound of the steel worker riveting outside is subdued. Such a condition, which seems almost unbelievable at first, is actually typical of the work rooms of the building, and is made possible only by an extensive installation of sound-absorbing materials.

This treatment, which was adopted for the purpose of increasing the efficiency of office workers, was planned in such a way as to prevent the trans-



VAULT TUBE STATION

Clerk opening locked carrier used in tube line connecting with security vault

mission of any sounds that originate either outside or inside the building. External noises are overcome by using heavy window glass, set rigidly in heavy frames, and by forced ventilation, so that a minimum of open windows is necessary at any time. Internal noises are largely overcome by the use of special sound-absorbing material on the ceilings, and by the proper selection and installation of sound-resisting materials.

The sound-absorbing element is a heavy layer of felt—composed of asbestos and cattle hair—which is cemented to the plaster or masonry surface with moisture-proof and heat-resisting cement. The exposed surface of the felt is then covered with a fabric selected to suit the location and the work to be done.

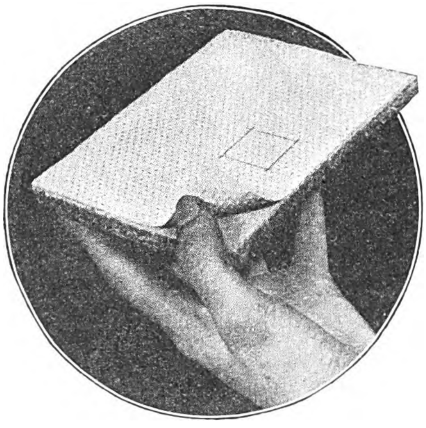
FOR the ceilings of the offices and kitchens, the fabric consists of a perforated oil cloth which, besides giving the maximum sound-absorbing effect, can be painted, washed, and kept in a clean and sanitary condition.

The treatment is used in all spaces where excessive noise might originate or where it is desirable or essential that quietness should prevail. Included in the spaces treated are all clerical working rooms where there is a considerable number of typewriters, adding machines, or similar office equipment, the doctors' examination rooms, laboratories of the employees' welfare department, and the pneumatic tube station. Sound-absorbing treatment has also been installed in the employees' dining rooms and kitchens, and in adjacent corridors.

In addition, all motors and machinery were, of course, placed as far away as possible from spaces where quiet was desirable. All office partitions were made of heavy metal with the glass rigidly fastened and braced, and careful selection was made of the plumbing, door checks, door fasteners, and other equipment to insure their quiet operation.

Although only a few months have elapsed since the opening of the building, the study and precaution taken in eliminating noise have already improved working conditions very noticeably.

Still another aid to the efficiency of employees are a series of teletype machines installed in several departments. These are the same as the machines used by newspaper press associations in transmitting news to their member newspapers. The teletype machine is, in effect, an ordinary typewriter with a telegraphic arrangement by means of which a message typed by an operator on the sending machine is automatically recorded on another machine, located, possibly, several hundred feet away in another floor of the building.



APPLIED TO CEILINGS

Sound-absorbing material, of cattle hair, asbestos, and perforated oil-cloth covering

In the New York Life building, the machines are used to transmit messages to and from the dividend division, the premium collection division, the policy loan division, the surrender value division, and the actuarial division.

There is, unfortunately, not space available to tell of the many other remarkable features to be found in this building. Given the space, one might describe the gigantic boilers, five stories underground, which are stoked automatically, human hands never touching the coal from the moment it is emptied into a bin at the street level until finally, as ash, it is carried by vacuum suction up to the street and into waiting trucks. Or one might well describe the mechanical ventilating system which carries clean, oil-filtered air throughout the five basement stories, and throughout all the company offices.

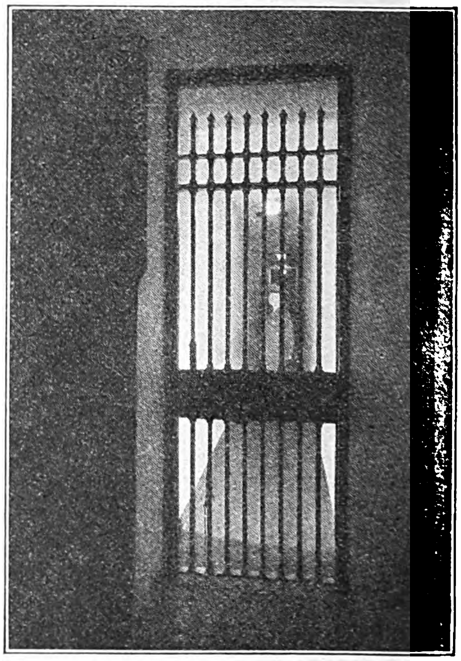
One might also describe the 100-ton refrigerating plant which supplies cool drinking water on every floor, as well as making ice cream and preserving food in storage. The kitchens themselves and the employees' dining rooms, decorated with colorful murals, are worth more than passing comment if only space permitted. Then there is the security vault of the company, the walls of which are protected by a series of finely strung wires, heavily insulated and so sensitive that the loosening of even one pebble in the wall will instantly set off an alarm. And there is the protective alley leading about the vault, fully lighted at all times, locked off by itself, patrolled by special guards—making it impossible for anyone with criminal intent to come even within striking distance of the walls.

THERE are the motors, of which there are more than 4000 horsepower in the building: over 200 motors, with an aggregate capacity of 2500 horsepower are required for building services exclusive of elevators.

There is the elaborate vacuum cleaning system which carries dirt and dust from all floors through concealed pipes to a special tank in the basement. There is the company's emergency hospital complete with women's ward, men's ward, treatment rooms, sun-ray lamps, and all modern equipment.

One could go on, it almost seems, indefinitely.

There can be no doubt that here we have a new conception of the business workshop, remarkable in its external beauty and remarkable in its application of scientific principles to modern business planning. One might say that when buildings such as these become common throughout the country there will be no excuse for any employee to shirk his duty.



SPECIAL VAULT GUARD

View of protective alley extending around outer walls of vault, patrolled by guard

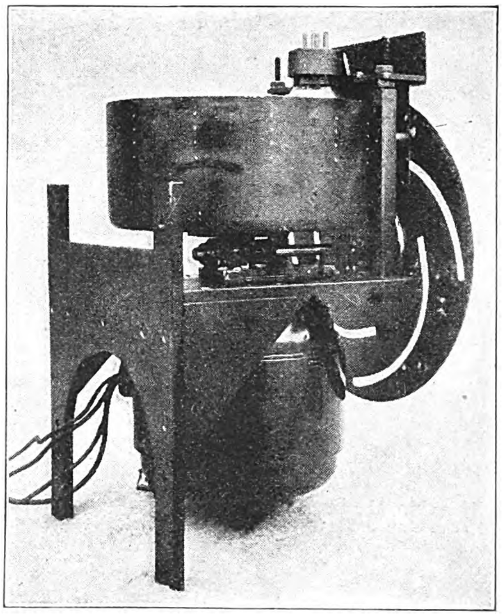
Television's Progress

By A. P. PECK

FOR years television has struggled to free itself from the confines of the laboratory and enter the home, to provide a welcome addition or supplement to the radio telephone receiver. Up to the present time, however, all attempts have been unavailing. Many experimental television receivers are now in use throughout the country, operated by radio amateurs who have made an intensive study of the situation, but even this may be considered a step in the laboratory process of development, and not "public" use in the general sense of the word.

A year or so ago, enthusiasm for television was at fever heat, and great possibilities were forecast for radio vision in the home. However, the simple theory of television did not prove so simple in practice, and the few "receivers" that were offered for sale turned out to be worthless for ordinary use. Then came a period of further intensive research during which several television transmitters were erected and placed on regular schedule so that tests of receivers could be conducted under actual working conditions. We show below two views of the transmitting equipment installed at the Jenkins Television Corporation laboratories in Jersey City, New Jersey. This company (See also page 526, June 1929 issue of the SCIENTIFIC AMERICAN for details of its earlier work) has also completed the design of the relatively simple televisor illustrated on this page and, at the time of writing, it is said that a visual reproducer will be on the market by Christmas of this year. Simplicity of operation and compactness are two qualities that are essential in a radiovisor. In the Jenkins unit, the simple scanning drum described before, (See reference above) has been retained, but a large-plate neon tube has been placed within it and the quartz or plated glass rods have been eliminated. The four-plate neon tube has been discarded and with it went the selector switch. In the present model, a slotted rotary shutter allows vision through only one of the holes at a time.

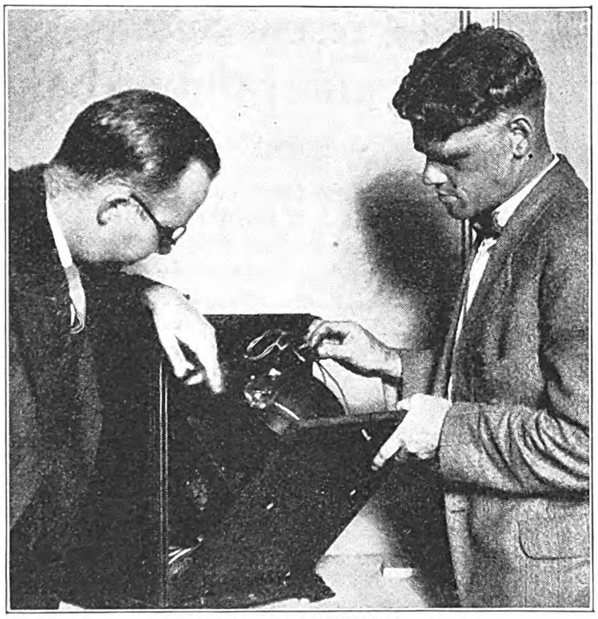
Synchronization is accomplished by the use of synchronous motors operating on 60-cycle alternating current. The mechanism is mounted on a chassis, as shown, and placed within a shadow-box.



"CHASSIS"

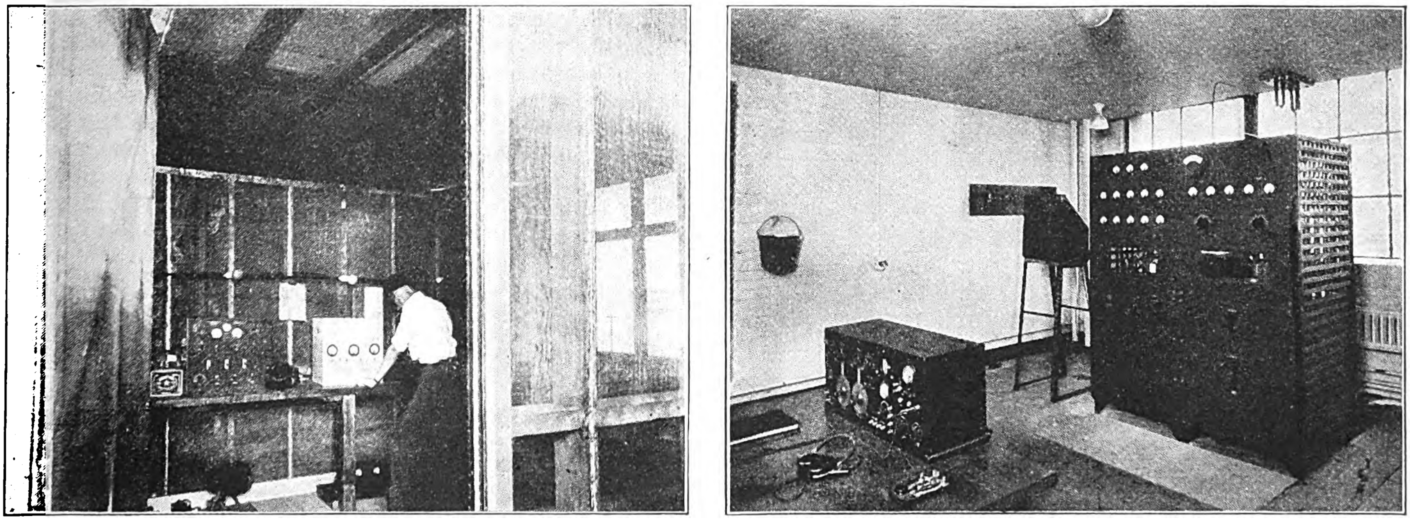
The motor is placed in a vertical position, with the scanning drum above. At the right is the shutter

THE TELEVISOR



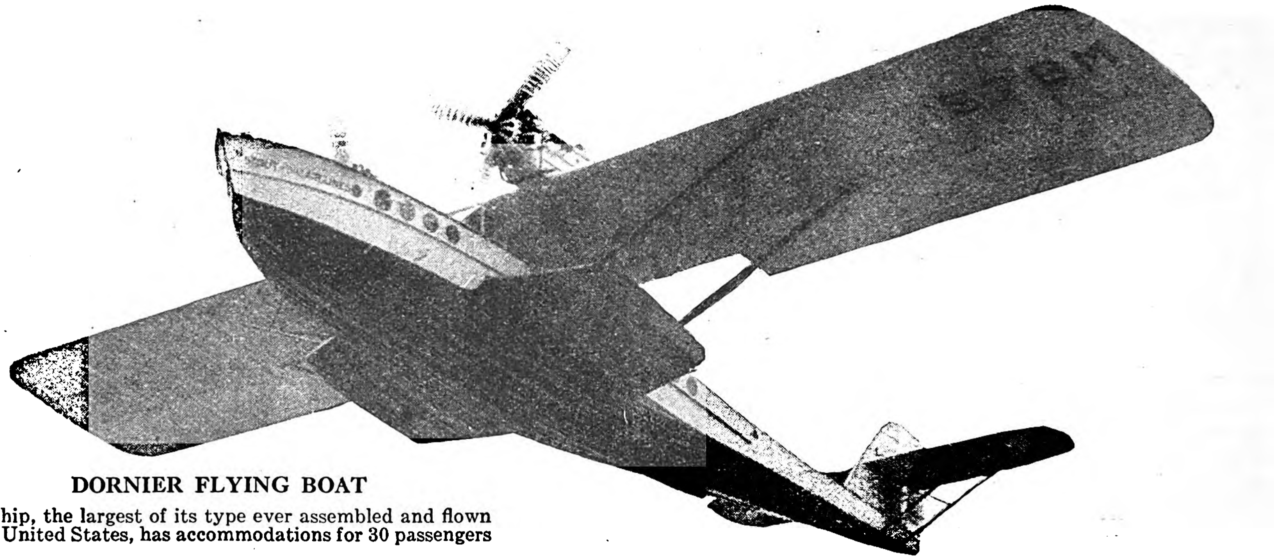
IN THE CABINET

The back of the cabinet is here let down to show the chassis bolted to it. Note the large-plate neon tube located within the scanning drum, close to the front



AT THE TELEVISION TRANSMITTER

The television pick-up and amplifiers are enclosed in copper-screen cages such as at the left above, to shield the instruments from disturbances. At the right is the transmitter with a possible output of five kilowatts, with the television monitor to the left of it



DORNIER FLYING BOAT
This ship, the largest of its type ever assembled and flown in the United States, has accommodations for 30 passengers

Giant Airplanes

Plans for the Future, and Present Successful Tests, Portend a New Era in Heavier-than-Air Flying

By REGINALD M. CLEVELAND

ARE we entering an era of giant airplanes? Will air transport of the near future be conducted in craft of wing-spread, payload, and horsepower far in excess of those now associated with passenger planes in the United States? There now seems to be a basis for an affirmative answer to both questions.

In Europe, at any rate, there is a very definite trend toward planes of large capacities. The tendency is not confined to isolated instances or to single countries. Germany—with Dr. Dornier's huge Do. X, the largest of all the big craft to have reached the stage of completion or near completion, and the biggest of the Junkers planes and Rohrbach flying boats—is perhaps in the van of this movement, but Italy presses close and Switzerland, Great Britain, France, and Spain are all at work on monsters of the air.

At least two major contentions lie behind this movement. The proponents of big planes hold, first, that in them the factor of safety is increased, and, secondly, that they are economically advantageous since, with increased size, the possible payload increases in higher ratio than does the total weight.

Both of these advantages have been claimed for the Do. X which astonished the air-minded world by its excellent performance under test last summer, when its twelve motors of 525 horsepower each lifted its great bulk from the surface of Lake Constance in 30 seconds. The safety factors stressed by its designer include its well-designed flying-boat hull, built to withstand wind currents strong enough to cause, in nautical parlance, a sea of Force 3 or Force 4; its height from the surface of water, which brings the low point of the propellor sweep 22 feet above a smooth sea; and room completely to separate piloting and navigation compartments from the passenger portion of the ship, leaving the control personnel entirely undisturbed in the performance of their duties.

With a useful load of 44,000 pounds and a payload of 22,000 pounds, the mighty Do. X should be capable of long-range flights on a profitable basis. It can accommodate a hundred passengers. So convincing have been its demonstration flights that the Luft Hansa has already ordered companion ships while Italy has also placed an order for a counterpart.

THIS giant is primarily intended for long-range cruises in Europe. The North Sea and the Mediterranean offer fertile fields for such operation, but it is altogether probable that a North Atlantic crossing will be made, with refueling at the Azores and the West Indies. Flying boats of this and the Rohrbach make, also built on a large scale, are to be put in operation on Germany's proposed South Atlantic service, where weather conditions present a more favorable average aspect than over the more northerly ocean.

The Do.X is regarded by Dr. Dornier as but a forerunner of still larger and mightier craft and by no means the ultimate in airplane size. It was he who, about two years ago, in an address in England, exploded theories long held that there was an upward limit to the size of heavier-than-air types. He demonstrated that resistance did not increase in proportion to the stepping up of size and that, aerodynamically, planes of enormous wing spread and wing thickness need not be confined to dreams of the visionary but can become practical realities.

Furnishing the proof of the pudding, his Do.X, with hull 130 feet long, has wings with the leading edges thicker than the depth of many an airplane fuselage. Through the wings access is had to the motor gondolas with their striking arrangement of motors in tandem, combining, with tractor and pusher, to furnish the needed 6300 horsepower. This tandem mounting, reducing as it does head resistance of a given number of motors to a marked degree, seems logical for giant planes, the size of which may ultimately be restricted only by the limitations of available motive power.

One of the two largest boats which have flown in America, purchased for passenger service on the lakes between Detroit and Cleveland, has the same motor arrangement. It is also a Dornier, built abroad but assembled at the naval aircraft plant at Philadelphia. Its four motors develop a total of 1700 horsepower, giving a top speed of 135 miles an hour and a cruising speed of 110 miles. In its test flights over the Delaware River in September it flew with capacity load at 120 miles an hour. It will carry 30 passengers. Its wing spread is 90 feet.

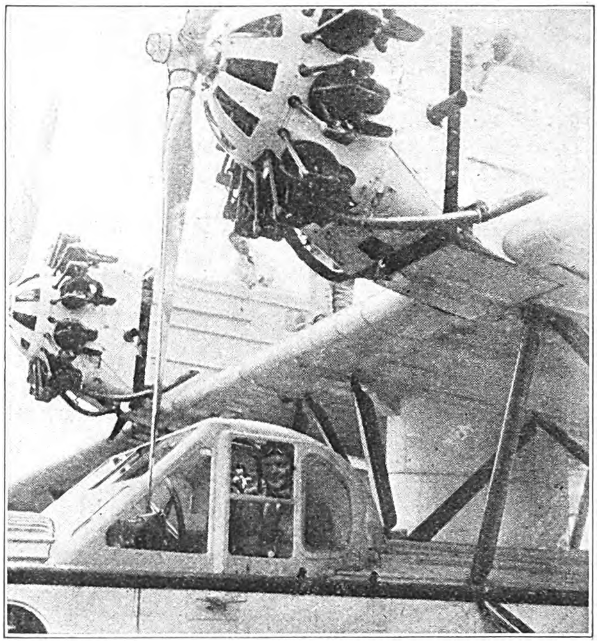
Another interesting sign of the big-plane movement in America is the 32-place monoplane launched in September by Anthony H. G. Fokker. This big passenger carrier, considered as whole, is the largest land plane yet built in America. With a span of 99 feet and an over-all length of 69 feet 10 inches, it has a payload of 8700 pounds, which indicates its high efficiency, as its total weight is only 22,500 pounds. Driven by four Pratt and Whitney Hornet motors, developing a total of 2100 horsepower and mounted in tandem in nacelles under the wings, it attained a high speed of 160 miles an hour and landed at 47 miles an hour in test flights at Teterboro. Either the two tractor or the two pusher motors—the latter with three-bladed propellors—served to keep the plane at a cruising speed of 110 miles. The interior arrangement allows for the seating of 30 passengers in addition to the pilots or 16 berths can be made up for night use. Serving pantries, toilets, baggage compartments, et cetera, make it a sort of combined Pullman and club car of the air.

Of arresting interest also is the Junkers 30-passenger liner which will probably be in flight by the time this issue reaches the public. The thick-wing principle is here employed to the full and the two 800 and two 400 horsepower motors are all housed in nacelles in the leading edge, streamlined into the wing surfaces. It seems probable that the Junkers oil-burning engine, which has had successful test flights, may be used. A speed of 105 miles an hour is expected.

With a wing span of 144 feet, this big craft has a fuselage length of 64.5 feet and a height of 17.4 feet. An auxilliary motor is used to control the rudders.

The interior of the Junkers plane is arranged in two decks. The upper provides 30 seats for daytime use and 26 berths for night flying. The lower deck will be used as a freight compartment.

The Swiss engineer, E. Manos, has also been at work on a plane of very large dimensions and with a number of interesting novelties of design. The wing span is given at 197 feet, the length at 120 feet, and the height at 32.8 feet. This particular plane is to have a total of 6000 horsepower but in this case the power is to be derived from only six enormous motors and these will be housed in an engine room and the six propellers operated by gearing. The arrangement is described as such that failure of two or three motors would not stop the revolution of the propellers but would merely slow them down. Flying speeds of from 118 to 155 miles an hour are expected. Beds are to be provided for passengers and the interior plans call for a restaurant and recreation rooms.



PILOTS' COCKPIT

This close-up of the Dornier plane, shown on the opposite page, gives an idea of the position of the pilots

One of the most consistent and enthusiastic advocates of the large plane is Gianni Caproni, the Italian designer. The creator of a number of very large bombing types during the war, he has devoted his attention for the last decade to designs on a grand scale. This intensive work along a definite pathway is to bear fruit and to bring the exceptionally large airplane to the American field for, through the participation of American capital in the organization of the Curtiss-Caproni Company, several big passenger planes are being pushed to completion. They were inspected recently by C. M. Keys, who heads many of the Curtiss interests, and he expressed his faith in their important role in flying in the United States.

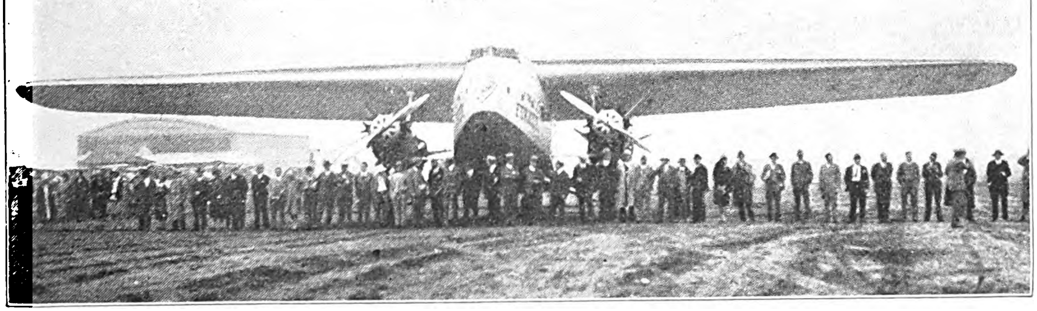
Signor Caproni has evolved three biplanes of progressively increasing size and designated them as the 1000, 2000, and 6000 horsepower ships. The first of these types has been constructed in quantity for use by the Italian army. The second has successfully passed flight tests and the largest is complete save for the installation of the 1000 horsepower motors.

In addition, the designer places great faith in a 3000 horsepower monoplane for which he claims an aerodynamic efficiency of from 12½ to 13. He believes that it can take off with a fuel load sufficient to give a maximum range of more than 6000 miles, but, very wisely, he does not advocate such a procedure. Instead, for the transatlantic service, which he predicts will be in operation earlier than most persons expect, he advocates stops for refueling, which would necessitate the Azores-West Indies route until such time, at any rate, as the proposed sea-dromes prove their practicability.

For service, say, from New York to the Pacific coast, Signor Caproni declares his 3000 horsepower plane could carry five tons of payload at an average speed of 135 miles an hour and require but one stop for refueling at some point about half way along the route.

The largest of his biplanes, the 6000 horsepower craft, has a wing spread of 167 feet. He feels that this is big enough for the present and sees no necessity of exceeding it in size. He has designed a special form of tubing for machines of this type to be used in frame construction, for which advantages of hitherto unattained lightness, combined with strength, are claimed. A service from Rome to South America is quite possible with these giant machines.

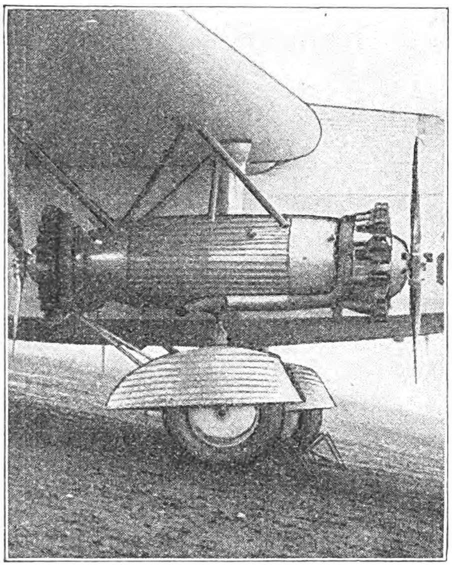
Spurred on by the evidences of the trend to big planes in Germany, Switzerland, and Italy, the British Air Ministry is bringing to completion a flying boat in the Blackburn works for which, compared with the Do.X, a greater range with equal load is claimed. Little has been revealed of the details of the craft, but it is designed to have a 1000 mile non-stop range; to carry 50 passengers; and to follow, in general principles of design, the present "Nile" type of the constructors. Size has been very greatly increased, how-



THE FOKKER F-32

This monoplane, designed to carry 32, was recently launched. It is powered with four Pratt and Whitney Hornets of 525 horsepower each, and is completely equipped for passenger comfort ever, over that model, as the sleeping accommodations for the passengers are to be in the wings. The ship, it is understood, will be powered by three Rolls-Royce engines.

The French have also entered the big plane race and the Farman Brothers, whose name must ever be associated with pioneering in aviation, plan two large models at home and in the American market. The smaller is to carry 25 passengers and be driven by two motors arranged in tandem, while the larger will be four motored and have a passenger capacity of 50. A company for American production of these types is in the making.



ENGINE MOUNTING
View of one of the nacelles on the Fokker F-32, showing mounting of the engines

EVEN Spain, where airplane production is not large, but interest in aviation is intense, has fallen into line. There a huge passenger craft is under construction by the Aeronautical Construction Company. It is a 50-passenger type and is to be powered by six motors of 750 horsepower each, mounted above the thick wing, which, as in the case of the Dornier design, gives means of access to the engines. The plane is expected to have a useful load of nine tons and a cruising radius of about 7000 miles.

New opportunities for profitable use in long-distance travel are opened up to these gigantic types by the demonstrated success of refueling in the air. It is quite conceivable that airline services of the near future may send up such massive types carrying only one half or one third of their rated fuel capacity, so as to make possible the transportation of more payload in the form of freight or passengers, and have them met by "nursing-bottle" planes at points well within the radius of the fuel load carried. If, for any reason, the refueling contact should be difficult or should miscarry, the plane would still have enough fuel in her tanks for a safe power landing. Normally, however, replenishment could take place in the air and the number of landings—admittedly the operation of greatest hazard and wear—could be much reduced.

The field for planes of great size seems to lie not only in more profitable service for long water and land routes in Europe and the United States but also in speeding transportation in countries where it is now especially difficult or arduous. The Central and South American fields and those of eastern Russia and Asia are particularly attractive in this regard. Railroad communication in many of these areas is non-existent or very inefficient. The important role of the airplane in such conditions has already been recognized by those most closely associated with the export side of the industry in this country.

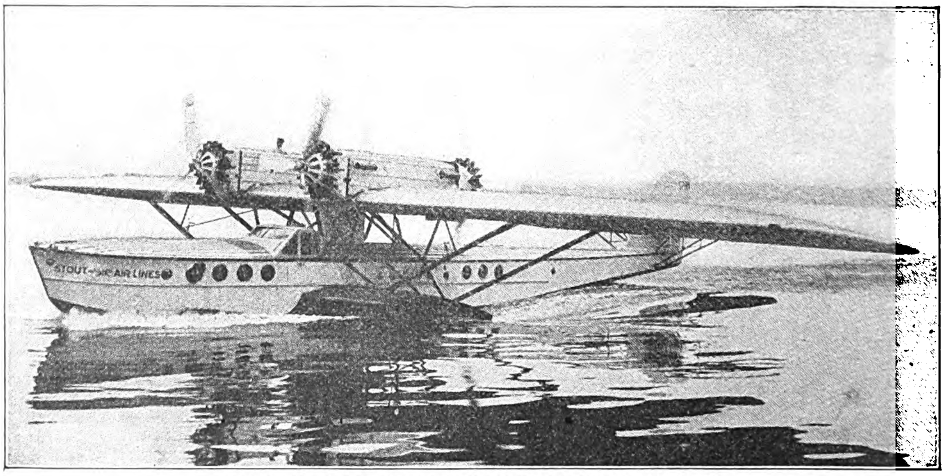
For example, F. B. Rentschler, President of the Aeronautical Chamber of Commerce, said recently in connection with the formation of an export subsidiary of the United Aircraft and Transport Corporation, which he also heads, that the airplane might well obviate the necessity of ever constructing railroads in lands marked by present lack of transportation facilities or by notably difficult terrain. He was not referring to giant planes, for which he does not see a demand as yet. However, the 25, 50, or 100-passenger plane—with its equivalent freight-carrying capacity—seems a logical type to employ as a substitute for railroad transport.

THE relative cost of establishing an airway, even when using such expensive mammoth types, and of building a railroad is, of course, altogether in favor of the airway. When one considers the flexibility of the air service and its advantages of speed, it is not unreasonable to doubt that there will be much more extension of railroad building in lands well suited to the use of the newer medium of the airways.

That big types are to have an opportunity to prove their utility in the long haul coastal service between the United States and her southern neighbors was evidenced recently by the christening by Mrs. Herbert Hoover of the *Buenos Aires*, first of a fleet of twelve huge Consolidated Commodore flying boats, purchased by the New York, Rio and Buenos Aires Airline for passenger service to South America. These big monoplanes, with accommodations for 32 passengers, are to follow each other into service at the rate of one a month until the full dozen has been delivered.

Advocates of the large plane contend that, in addition to its economic and safety advantages, it also makes possible greatly increased comfort for the air traveler. The roominess of the Pullman car, the space in which to move around and "stretch one's legs," are lacking even in the largest of our present plane types although the seating is fully as comfortable. But the facilities are equalled or exceeded in the giant types which have been under discussion here, and in them, the air traveler can be as much at his ease as in his office or his home and, at the same time, be eating up the miles at a rate of 120 per hour or better.

DAILY one sees the predictions of the dreamers of the last century coming to practical realization. The British have a tiny plane for the private flyer, having a wing span of only 25 feet and designed to make 80 miles an hour and do 40 miles on a gallon of petrol. The autogiro came down at the National Air Races in a 20-foot circle in an almost perpendicular landing. And now Dr. Dornier and his fellow designers of aerial titans have shown that planes with wing spans in the neighborhood of 200 feet and with enough horsepower to drive a sizable steamship can take off with scores of passengers, rise, maneuver, and fly in a way to put any but the most skillful of the birds to shame.



THE DORNIER FLYING BOAT TAXYING
One of the sponsons or stubs on the side of the hull, used in place of wing-tip floats, shows in this photograph. In this ship the engines are mounted in tandem pairs on the wing

Award of the Scientific American Medal

An Awakened Interest in Sea Safety Has Brought Results

PROF. REGINALD A. FESSENDEN, WINNER OF THE COMPETITION

This picture shows Professor Fessenden at work at his laboratory near Boston

FOR the ninth time the SCIENTIFIC AMERICAN medal has been bestowed and this time for outstanding achievement in the field of marine safety. This medal is donated by the SCIENTIFIC AMERICAN and is awarded by the American Museum of Safety, a non-commercial organization which was the first in the field of safety in this country. The decision was made by a remarkable committee of experts including naval officers of high rank, captains of the Merchant Marine, naval architects, and editors of professional journals.

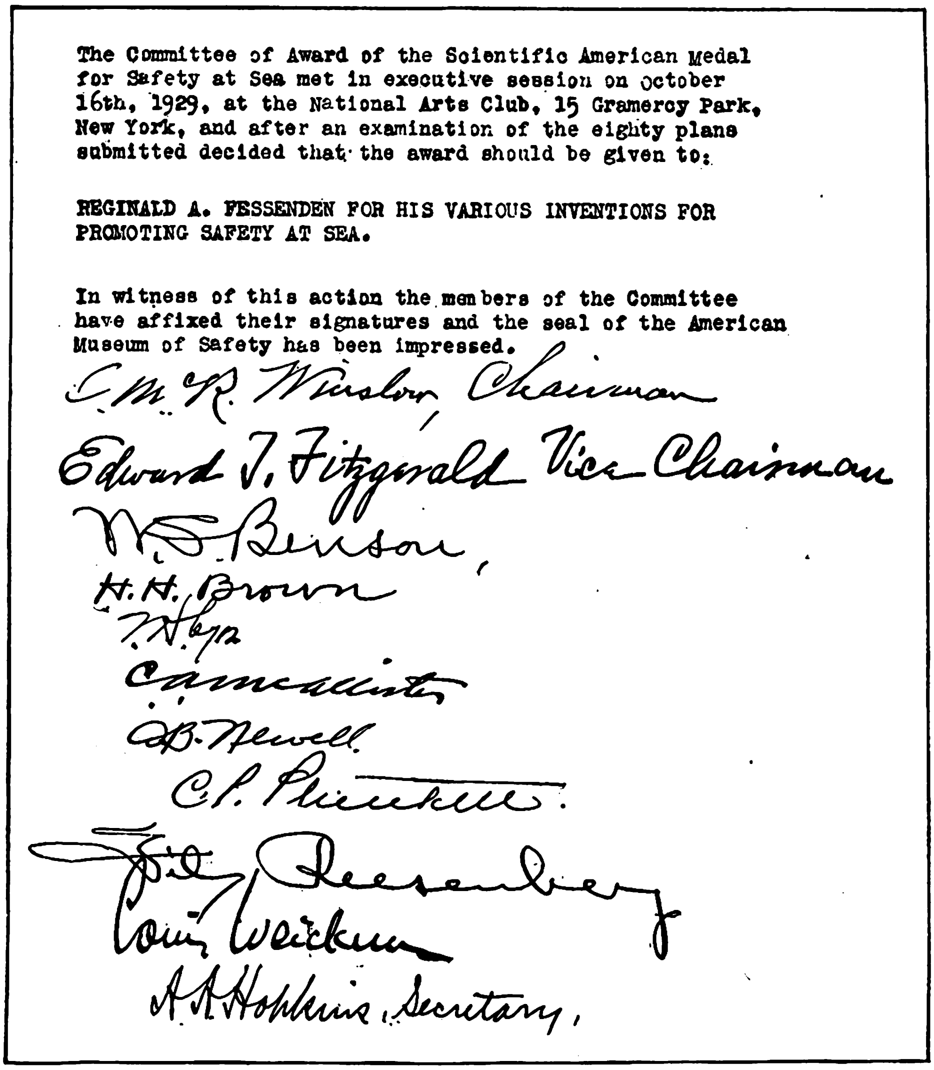
The Committee met in executive session and after an examination of 80 projects, awarded the SCIENTIFIC AMERICAN Gold Medal to Professor Reginald A. Fessenden "for his various inventions for promoting safety at sea," as the citation denominates. It should be noted that several inventions, all making for sea safety, are involved. We shall go into the subject in greater detail in our next issue, but we cannot resist mentioning here one of his achievements, the fathometer, by which the ability to obtain accurate and frequent soundings and to compare them with the chart, allows a vessel's course and position to be constantly known.

The Committee considered that several other devices were so good as to warrant the citation of three "Honorable Mentions." The first is a device invented by Mr. J. Lyell Wilson, Assistant Chief Surveyor, American Bureau of Shipping, for a stability meter which not only makes for safety of the ship but also assists in the economical operation of the vessel.

The second device to receive honorable mention is an attachment for life boats to insure their passing over obstacles. This is known as a sea "skate" and is a demountable detachment which permits a life boat to be launched even with a 46 degree list. This is the invention of A. P. Schat of Utrecht, Holland.

The third device is a folding life raft or net, constructed of balsa wood. This is the invention of Jesse W. Reno of New York City.

REAR-ADMIRAL C. McR. WINSLOW, U. S. N. (Ret.), presided at the meeting. He is well known as a naval officer of the highest type. Two other rear-admirals gave their counsel to the Committee, Rear-Admiral W. S. Benson, U. S. N. (Ret.), Chief of Operations during the World War, and Rear-Admiral C. P. Plunkett, U. S. N. (Ret.), who was Commandant of the Brooklyn Navy Yard until recently. Vice-Ch'm. Captain E. T. Fitzgerald, U. S. N. (Ret.), Board of Transportation, N. Y. City, rendered great assistance in acting as "Judge-Advocate" in explaining the plans. Captains C. A. McAllister, Pres. American Bureau of Shipping; T. H. Lyon, Port Captain, International Mercantile Marine; H. McConkey, Port Captain, Cunard Steamship Co., Ltd.; and Felix Riesenberg, Martin Motors, Inc., gave wise professional advice. The technical press was represented by Messrs. H. H. Brown, Editor, *Marine Engineering and Shipping Age*, A. B. Newell, Editor, *Motor Ship*, and A. A. Hopkins, Assoc. Ed. SCIENTIFIC AMERICAN. Mr. L. Weickum gave valuable assistance on publicity.



The Committee of Award of the Scientific American Medal for Safety at Sea met in executive session on October 16th, 1929, at the National Arts Club, 15 Gramercy Park, New York, and after an examination of the eighty plans submitted decided that the award should be given to:

REGINALD A. FESSENDEN FOR HIS VARIOUS INVENTIONS FOR PROMOTING SAFETY AT SEA.

In witness of this action the members of the Committee have affixed their signatures and the seal of the American Museum of Safety has been impressed.

C. McR. Winslow Chairman
Edward J. Fitzgerald Vice Chairman
W. S. Benson
H. H. Brown
T. H. Lyon
C. A. McAllister
A. B. Newell
C. P. Plunkett
Felix Riesenberg
Louis Weickum
A. A. Hopkins, Secretary

CITATION GIVING THE AWARD

This is the formal citation signed by members of the Committee which was made up of naval officers of high rank, marine architects, and engineers, all men of expert knowledge of the sea

Behind the Scenes in Modern Archeology

The Modern Archeologist Is a Scientist and His Science Contains Keen Interest. At Times It Smacks of Adventure. How He Restores and Exhibits Faded Discoveries Made in the Field

By **HORACE H. F. JAYNE***

Director, The Museum of the University of Pennsylvania

THE usual conception of the duties of an archeologist involve only wielding a pick and shovel or directing vast groups of men to remove sand dunes lying above hoards of the treasures of antiquity.

Few realize that this forms only a really very small part of an archeologist's responsibilities, and that on the one hand he must have extensive theoretical and practical knowledge before he digs at all, and on the other that he must learn how to preserve and restore in the best possible manner the objects his excavations yield. A trained archeologist knows full well that he is dealing with priceless documents and the evidence which they may hold must by every means be retrieved. It is this that marks the difference between an archeologist and the outlaw "pot-hunter" or the treasure seeker, whose sole concern is to fill a museum case with impressive but generally useless and undocumented specimens.

MUCH of the initial work of cleaning and restoring material is done in the field. An ingenious archeologist even recaptures the form of an object that has totally disintegrated before a spadeful of earth is turned. The substance of a thing may wholly disappear in the course of time and yet leave an imprint of its form in the layer of earth that has carried it. Many readers will remember those casts of human bodies made during the excavations at Pompeii, where plaster was poured into the hollow left after all that was human had disappeared. Never was the ghost of death's agony so vividly materialized: a modern miracle had recaptured the last dreadful moment of a man who perished 1900 years ago.

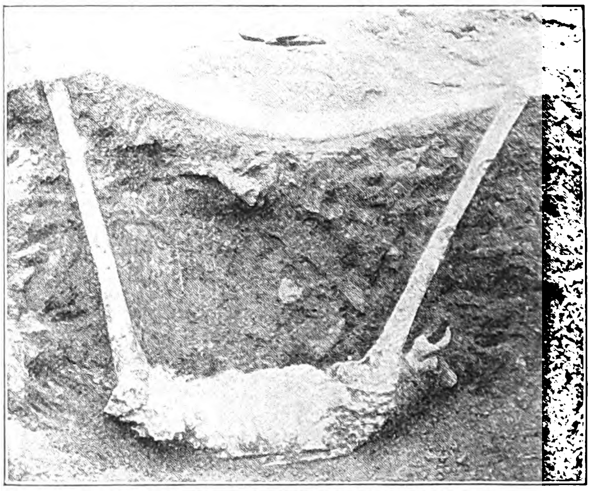
THE DELICATE STAGE

When fragile objects are being revealed, a camel's hair brush is generally used

Another illustration of the value of this technique is to be found in the remarkable feat performed by Mr. Woolley, Director of the Joint Expedition of the Museum of the University of Pennsylvania and the British Museum, at Ur of the Chaldees. [See also page 471 of this issue.—The Editor] As little by little his workers uncovered the strata of earth above the royal tombs, in the now famous predynastic cemetery, Mr. Woolley noticed a small round hole extending into the earth and a few feet away another hole of the same dimensions and direction. Though unaware of what these represented, his great archeological experience told him that here might be a clue to something vitally important. Halting the work he prepared a "soup" of plaster of Paris and poured it meticulously into the holes until they could hold no more.

After allowing the solution to set, the earth was carefully cleared away around the newly created plaster form, revealing a perfect reproduction of a harp's body and uprights. It had been made of wood originally but must have long since decayed and only a mould of its shape remained, of which the plaster filled every crevice. Even the seven fine strings of the harp were recaptured in plaster as the illustration shows, and the metal ornaments, originally fastened to the wood frame, were found adhering in their proper places to the new plaster form of the harp. Had Mr. Woolley been a hasty excavator or possessed of a mind less keen and ingenious, this inestimable piece of archeological evidence would have been lost forever.

THESE belong certainly to the more spectacular class of restorations made during the course of excavating, yet virtually every object, as it is unearthed, is subjected to an equally careful treatment. Where fragile skeletal material is to be removed, it is often impregnated with wax to strengthen the weakened structure of the bones. Where the excavator is dealing with anything particularly delicate the spade and pick are of course immediately abandoned, even the coarse whisk broom is laid aside and hands alone are used in the work; when even these are too clumsy, although they have become extremely sensitive by many a day of practice, then recourse is had to a fine camel's hair brush.



CAST OF A SUMERIAN HARP

Made in position by pouring plaster into the hollow left after the wooden frame had wholly disintegrated

---

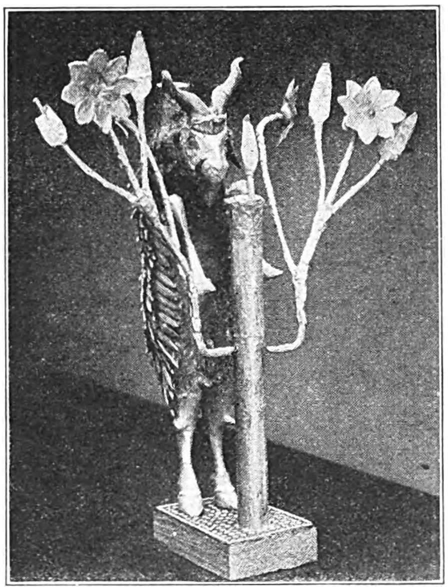
*See "Among Our Contributors," page 469.

Further careful work is carried on also at the actual site where scattered fragments of broken vessels are brought together and the whole rebuilt, and where fragile objects are strengthened and made ready for packing so that they may be safely transported to the museums for which they are destined. Because every object is recognized as a document of unpredictable importance, every effort is made to preserve it intact so that not a bit of historical evidence is lost.

Restoration and repair for which the facilities at the site are insufficient are further pursued when the object reaches the museum. It may often happen that months of treatment are necessary before an object is ready for displaying in a case for the instruction and enjoyment of the public. Those concerned with archeological finds and their uses as a means for education are becoming more conscious of the necessity of presenting these properly to the public. In the past, curators were content to crowd their cases indiscriminately with the various finds sent back by their expeditions. A pottery vessel badly repaired, a heavily corroded metal object, a handful of mixed beads were all considered good enough for the public.

TODAY all this is changed. We have learned that the most casual visitor responds ten times more intelligently to the historical and artistic messages of a vessel so cleverly repaired as to seem almost in its original condition; that he derives more instruction from a thing of metal if it is cleaned and gleams with its original luster or from beads graded and strung as undoubtedly they had been in the past. With the actual installation, care must be taken to avoid the theatric, but every step that leads to a less crowded setting is one in the right direction.

In short, it is now the duty of museum curators so to display the finds of the archeologists that the messages they bear are as comprehensible and interesting to the public as to the specialist. These documents from the past can thus exert the subtle but invaluable educational force of which they are so richly possessed.



GOLD AND SILVER GOAT

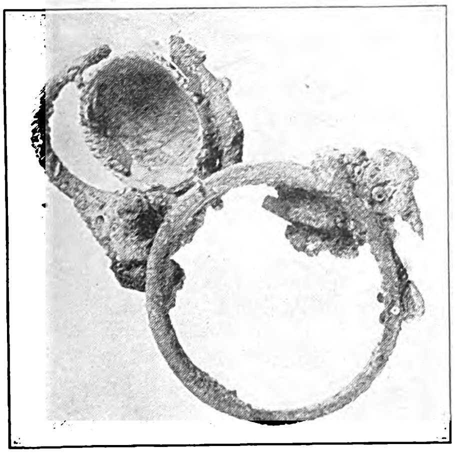
Probably the decoration of a harp. Found at Ur and most carefully restored

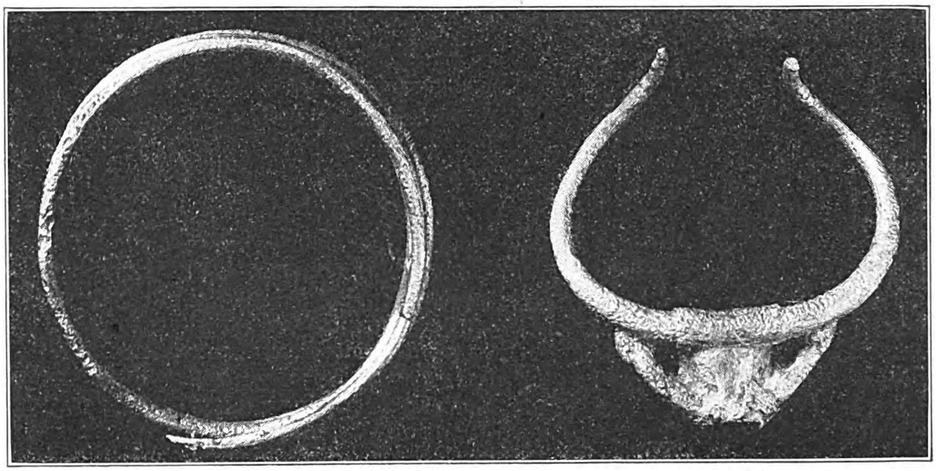
An outstanding example that illustrates well this modern tendency in the conduct of our archeological museums can be seen in the case of the recent finds from the Ur excavations of the joint expedition of the British Museum and the Museum of the University of Pennsylvania. Although on the field all the objects are subjected by Mr. Woolley to the same exacting care we have mentioned in the case of the harp found last season, yet the study and research, the cleaning, repairing, and restoring is carried even further after the objects which fall to the lot of the University Museum arrive in this country.

Before these can be installed in the cases of the Museum's exhibition collections, even before they can be handled by scholars and experts, they must undergo many varied treatments. In the hands of the expert restorer the pottery vessels must have lacking fragments supplied and colored to harmonize with the original ware; the surface of Babylonian tablets, which are the oldest written documents in existence, must be cleaned with delicate brushes and often baked to preserve them absolutely intact for future scholars to study; the delicate inlaid plaques, parts of which may have become hoplessly confused, must be reassembled and reset—they are the picture puzzles of 5000 years ago; the treasures of countless beads of lapis lazuli, carnelian, agate, and precious metals must be sorted with the utmost care. One of the Museum's staff spent day after day at his work, recreating the delicate headdresses and necklaces, diadems and girdles of the predynastic jewelers.

The metal vessels and objects found at Ur have perhaps presented the most difficult problems. To restore them to their original form and luster, the assistance of the most modern knowledge in physics and chemistry has been required. Professor A. K. Graham of the Physics Department of the University of Pennsylvania, was entrusted with this work. The Royal Tombs of Ur yielded an impressive collection of delicate vessels in gold and weapons and ornaments of silver and electrum, as well as scores in the more commonplace bronze. After 5000 years the weight of the earth upon them had often crushed these fragile objects completely out of shape; moisture had oxidized others so completely that they came from the field as mere shapeless masses of corroded metal. Here were problems indeed for the chemist and physicist.

THE metallurgists of these early times, as Dr. Graham reports, were not able to refine the precious metals perfectly and many impurities necessarily remained in their composition. Particularly is this true of the silver objects from Ur. Often their shape, their decorative detail, their

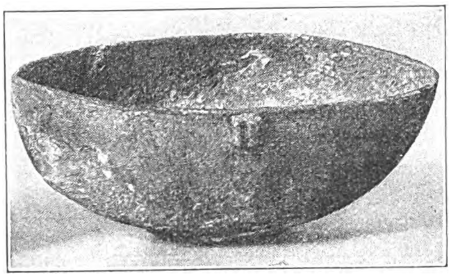




SILVER OBJECTS BEFORE AND AFTER CLEANING

At the left they are shown as they arrived at the University of Pennsylvania Museum; at the right after the processes described in the text had been applied. One object is an antelope head and the other a bracelet. Several arts contributed to these restorations quality are completely obscured until they have been subjected to an exacting course of chemical treatment. The earlier methods resulting from the investigations of Dr. Alexander Scott of the British Museum and those developed by Dr. Fink of the Metropolitan Museum were called into play, but even these had to be modified in the case of each individual object, since no general technique was found to apply to all cases.

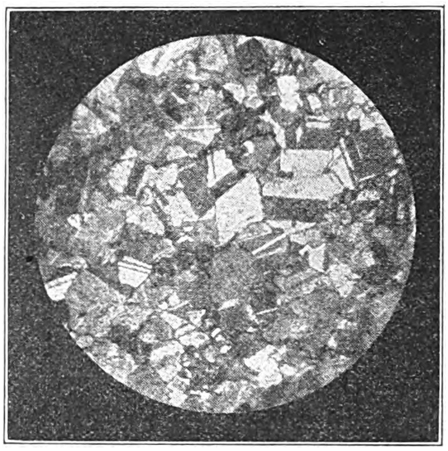
THE tiny silver head of an antelope shown in one of the illustrations, a minute masterpiece of Sumerian sculpture, is a singularly satisfactory example of the course of treatment necessary, and the happy results. It came to the Museum in the form first shown. The parts which later were discovered to be the antlers surrounded a delicate gold vanity box in the form of a shell. For the rest it was a conglomeration that might yield almost anything. It was subjected first to electrolysis in a bath of weak caustic soda for several days continuously. This was followed by repeated boiling in formic and, little by little, the true shapes began to emerge. What before this treatment had seemed a solid ring fell away from the mass and was revealed as a delicately wrought bracelet of several turns of tapered silver wire. The little head itself, after it came from its succession of baths, was gently brushed and a sharp pick was used under a magnifying glass to remove the loosened crust from the fine lines of decoration. It was then once again washed, dried, lacquered, and mounted on a tiny pedestal. Seldom has modern science retrieved so perfectly from the past an object of such pre-eminent artistic beauty and archeological importance.



CORRODED BOWL

Before being treated electrolytically and chemically by Professor A. K. Graham

Another illustration of the worth of all this trouble and the uses of chemical research in the restoration of archeological remains is found in the silver bowl shown in another pair of illustrations. This vessel, with its pleasing lines, had rested in another silver bowl so that a portion of the outer surface was in almost a perfect state of preservation and thus gave a standard to achieve for the rest of the surface which, both inside and out, was heavily covered, as may be seen in the first figure. The actual process in this instance was not difficult. The bowl responded very well to the electrolytic treatment and after subsequent cleaning and lacquering is in a condition closely approximating, we may well believe, its original appearance.



THE EVIDENCE

Photomicrograph of minute fragment from a silver vessel at Ur. See the text

In connection with this bowl an unexpected archeological discovery was also made. On one side of the vessel, to the right of the electrum lug shown in the photograph, a marking came to light after the treatment—a conventional bull's leg engraved below the rim. This we now know was the particular "hall mark," unquestionably the earliest yet recorded, of King Meskalam Dug; it has been discovered also on his ceremonial implements and on the gold and silver spear points found with the body-guard buried in his tomb.

It is discoveries like these that repay so handsomely the enormous amount of care and research to which the objects are subjected. The contents of the tomb of King Tutankhamen were in a like manner treated with meticulous care, so that today they are the most perfect examples of ancient Egyptian artistry preserved, even as they are among the richest finds ever credited to archeological science.

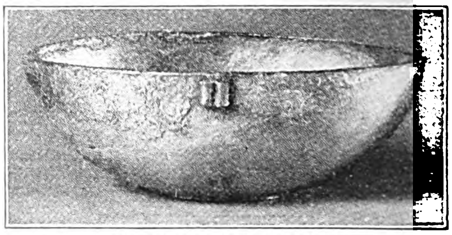
THESE metallurgical researches, in connection with the silver vessels found at Ur, were extended even further by Professor Graham, than merely restoring them for exhibition. The very process used in fashioning them was sought by examining the microscopic structure of minute fragments of the metal. A photomicrograph of one of these is reproduced. From this we may safely deduce that a bowl like that shown would have gone through the following stages in its manufacture:

After the native silver was refined and properly alloyed it would be cast into a convenient form. Then by alternately heating in a furnace and rolling on a flat surface a sheet of desired thickness would be obtained. Next, the Sumerian silversmith would study the form of the vessel to be produced, cut a flat sheet according to the chosen pattern and hammer it over prepared forms to bring it to the shape desired. During this hammering the vessel would have to be annealed—that is, alternately heated and cooled—about three or four times, to keep the metal soft enough to be worked. Finally the surface was burnished and the completed vessel marked with the insignia of the King.

It is the structure of the silver as revealed by the microscope which permits us to be so certain of this process. It is plainly the structure of an annealed metal and the numerous cases of twinning in the crystalline mass indicate a number of previous workings. It is the same method used by the silversmiths of today, the ancestry of whose skill is therefore traced back by these researches at least 5000 years.

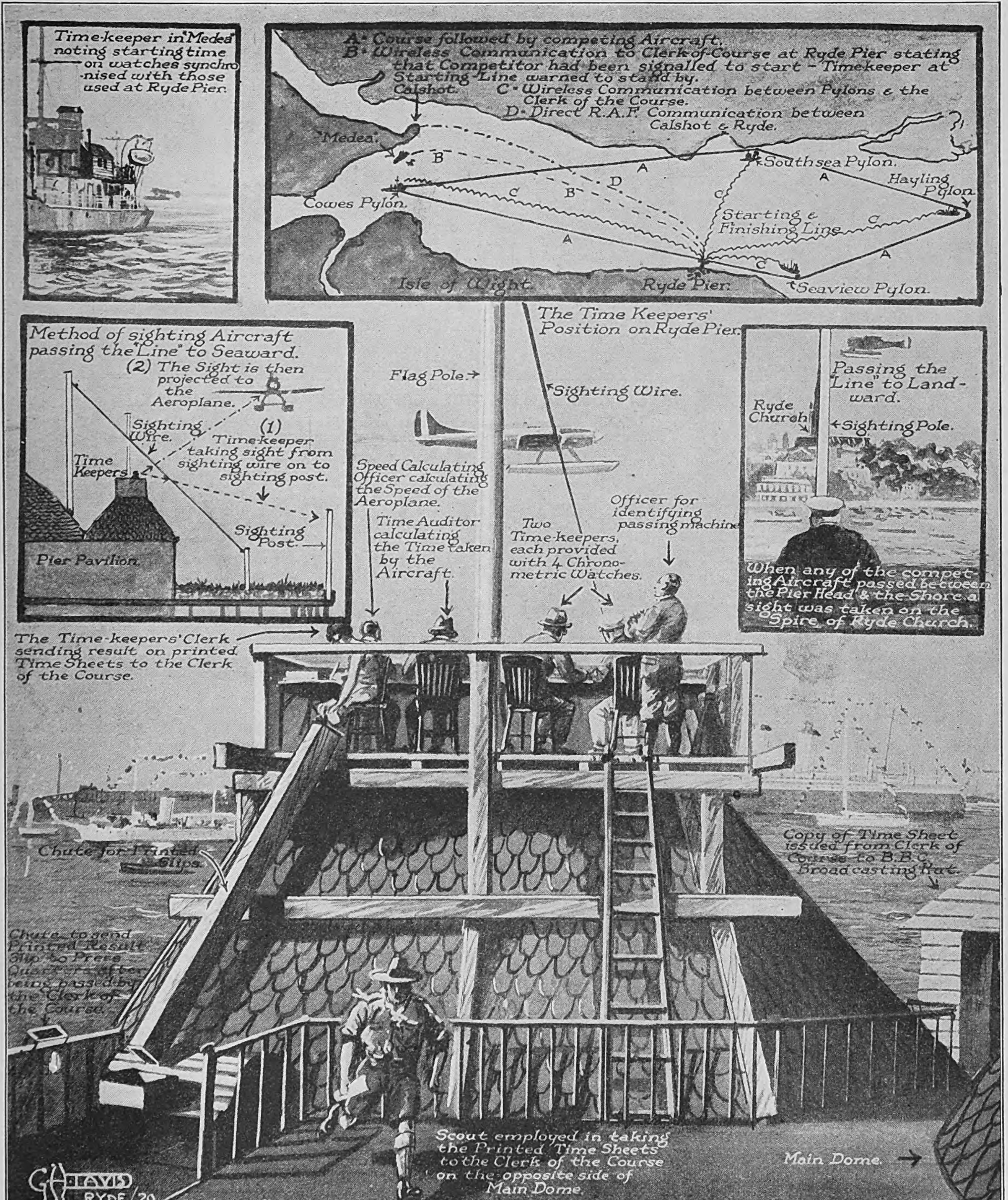
IF we compare the archeology of the past century, concerned only with despoiling the sites of ancient civilization of inscribed monuments and works of art; neglecting, even heedlessly destroying, historical knowledge latent in humble objects of every sort; failing to investigate properly and above all to interpret the objects actually brought back from the field—if we compare this work with that carried on by the archeologists of today, we gain an insight of how very great has been the advance of the science. It is no longer a dry subject, interesting only learned philologists or antiquarians, to be associated with the dusty corridors of the museums of the past; it is now a very vital study, calling to its service men of adventurous natures and long training for the field work, scientists who have specialized in other fields for solving its problems, experts in virtually every walk of life.

The findings of archeology, moreover, are today being so exhibited and interpreted that they have a universal appeal and even the most casual museum visitor is thrilled by the pictures and stories they tell about the customs of long vanished civilizations.



THE SAME BOWL

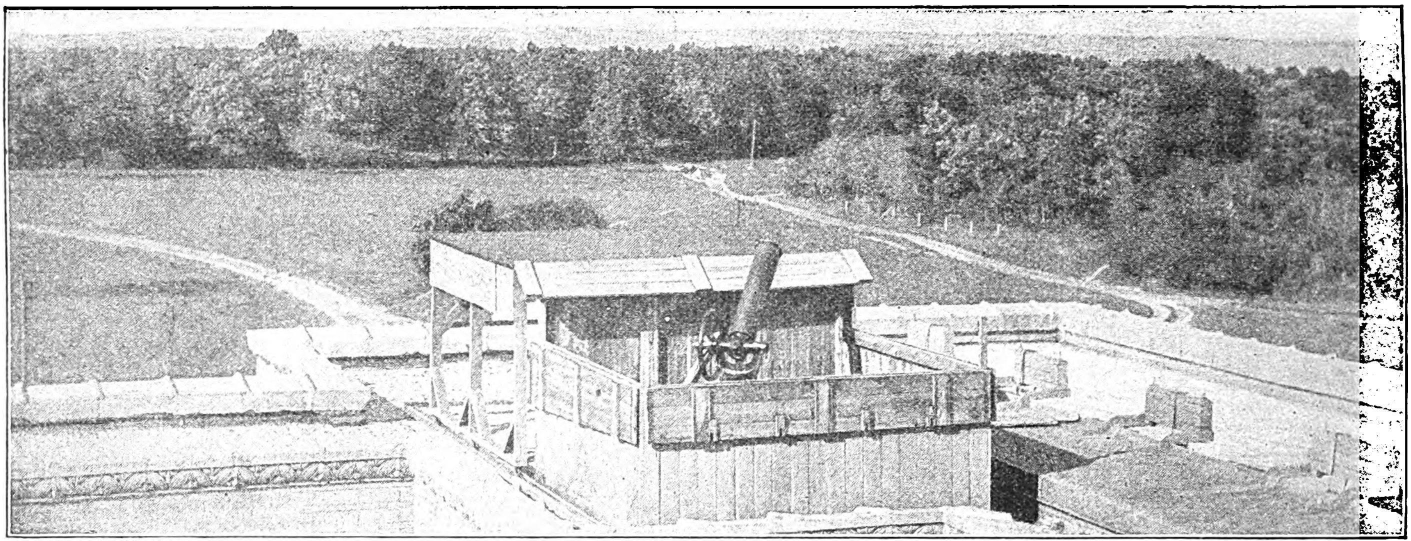
Virtually a perfect restoration. The bull's leg referred to in the text shows faintly


Time-keeper in "Medea" noting starting time on watches synchronised with those used at Ryde Pier.
A = Course followed by competing Aircraft.
B = Wireless Communication to Clerk-of-Course at Ryde Pier stating that Competitor had been signalled to start – Timekeeper at Starting Line warned to stand by.
Calshot.
C = Wireless Communication between Pylons & the Clerk of the Course.
D = Direct R.A.F. Communication between Calshot & Ryde.
"Medea."
Cowes Pylon.
Southsea Pylon.
Hayling Pylon.
Starting & Finishing Line.
Isle of Wight.
Ryde Pier.
Seaview Pylon.
A
B
C
D
The Time Keepers' Position on Ryde Pier.
Method of sighting Aircraft passing the "Line" to Seaward.
(2) The Sight is then projected to the Aeroplane.
Sighting Wire.
(1) Time-keeper taking sight from sighting wire on to sighting post.
Time Keepers.
Sighting Post.
Pier Pavilion.
Flag Pole.
Sighting Wire.
Speed Calculating Officer calculating the Speed of the Aeroplane.
Time Auditor calculating the Time taken by the Aircraft.
Two Time-keepers, each provided with 4 Chronometric Watches.
Officer for identifying passing machine.
Passing the "Line" to Landward.
Ryde Church.
Sighting Pole.
When any of the competing Aircraft passed between the Pier Head & the Shore a sight was taken on the Spire of Ryde Church.
The Time-keepers' Clerk sending result on printed Time Sheets to the Clerk of the Course.
Chute for Printed Slips.
Copy of Time Sheet issued from Clerk of Course to B.B.C. Broadcasting Hut.
Chute to send Printed Result Slip to Press Quarters after being passed by the Clerk of the Course.
Scout employed in taking the Printed Time Sheets to the Clerk of the Course on the opposite side of Main Dome.
Main Dome.
G. H. Davis RYDE/29

Copyright The Illustrated London News

Timing the Schneider Cup Races: Over 300 Miles Per Hour

TWO timekeepers, Colonel Lindsay Lloyd and Mr. A. G. Reynolds, each with four chronometric watches, timed the seaplanes in this year's Schneider Trophy Contest from a platform built atop a dome of a pavilion on Ryde Pier, the starting and stopping point. As gunfire from the *Medea* started each plane, a timekeeper on board informed the Clerk of the Course at Ryde Pier by wireless, and he informed the timekeepers at the starting line. These sighted the plane against a wire if it passed to seaward and on the spire of Ryde Church if it passed to landward, and "split" their stop watches so there was a double check on the time. As the machine completed its lap, the time was noted and given to an auditor who worked out the elapsed time and passed his calculations on to a calculator who worked out the plane's speed. The results were then passed down a chute to the Clerk of the Course.



Courtesy Yerkes Observatory

A SPECIAL COMET-SEEKING TELESCOPE ON THE ROOF OF YERKES OBSERVATORY

It has a hand wheel which facilitates sweeping the skies. A diagonal mirror within directs the rays into a fixed, comfortable eyepiece in the horizontal axis. The special qualities are great light gathering power (large objective) with short focal length and low magnification

The Puzzles of the Comets—II

Research Indicates That the Sun Picked Up Its Family of Comets Only Recently While Passing Through Orion

By HENRY NORRIS RUSSELL, Ph.D.

Director of the Observatory and Chairman of the Department of Astronomy at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

WE told last month of some of the problems, solved or still awaiting an answer, which comets present to the astronomer. But the tale is too long for a page or two and there is more worth the telling.

Comets are members of our solar system, or at least this is true of all those which have been accurately enough observed to settle the question. In a few cases the velocity of the comet when under observation near the sun was greater than the maximum value for a body moving in even the longest elliptic orbit and returning regularly to the sun. But in every one of these cases calculations of the attraction of the planets showed that they had speeded up the comet as it approached the sun and that, when well outside Neptune's orbit, its speed was below the critical limit or at most exceeded it by less than the errors of observation. The comets which we see are therefore old timers and not newcomers, although some of them have lingered long in the outer darkness.

Delavan's Comet of 1914 is a good example. Making allowance for the fact that it never came very near the sun, and was unusually remote from the earth, this was the greatest comet of recent times. But the time when last it came home to the sun was far from recent—about 11,000,000 years ago according to Van Biesbroeck's careful calculations. To predict such an enormous interval from the motion shown by a couple of years' observations is obviously possible only if the latter are very precise, and even so there is an uncertainty of a couple of millions of years in the date of the last return.

But this is an extreme case. This comet at its remotest must have been about 1½ light years distant from the sun, and if it had gone much farther the attraction of some other star might have taken it away from our system. But one must not think of it as slipping away from the sun's control to swing into that of the star and pass close to it as it did once near the sun.

FOR the comet, although far from the sun and gradually going farther, would still share the sun's motion through space. Could a remote observer see it as well as the sun he would observe the two traveling in almost parallel paths, traversing a light year's distance in 15,000 years of time (by our earthly reckoning) and separating from one another by only 1/200 of a light year in that interval. It would be obvious that there was some relation between the two bodies.

But while the comet's motion, compared with that of the sun, is so slow, its motion relative to any other star would be rapid, for these stars have motions of their own quite different from the sun's. Should the comet escape from the sun's sphere of influence, it would be very little deflected from a straight course by the attraction of any other star, unless by chance it happened to be moving almost directly toward it. Such a close approach would not happen on the average until billions of years and even more had elapsed. For all this time the escaped comet would be a lonely wanderer in the depths of interstellar space—cold, dark, and invisible.

Such a fate as this may befall a comet in another way. At some perihelion passage it may be speeded up by the attraction of the planets until it exceeds the velocity of escape, and not slowed up on its departure enough to undo the damage. It will then set out on an independent career without any help from the attraction of the stars and become a homeless vagabond.

Our solar system must therefore be steadily losing its comets, for the escape process is irreversible; it can happen but once to a given comet and the chance of recruiting the sun's diminishing army by picking up a comet which comes in from interstellar space and is slowed down by planetary attraction is quite negligible.

There are still thousands of comets in our system; probably hundreds of thousands, for the evidence indicates that at least a thousand approach the sun every century (allowing for more than escape discovery) and very many centuries will elapse before the majority of these will return. A few millions of years ago there must have been even more comets. Can we carry this reckoning back over the 4,000,000,000 years or so since the birth of the planets? If so, was the whole sky full of comets then?

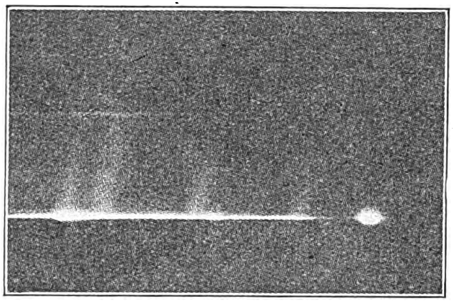
If we attempt to answer these questions we must recall that the danger that a comet may be flung off into space by planetary perturbations is not the only one which besets it. Comets, even if they remain within our system indefinitely, are subject to steady depletion of their own substance by the very processes which make them conspicuous. The greater show a comet makes, the faster it is wasting away, for the gas and dust which is ejected from the nucleus to form the head and is swept away by radiation pressure to create the tail never returns. We have direct photographic evidence that the tail particles move faster and faster the farther they go. The tail fades out at the end not because the gases have stopped shining but only because they are spread out so widely that the light no longer affects the eye or the photographic plate. Each molecule or dust speck must fly on and on at speeds which are by this time much higher than those of the stars in their courses, and become lost in the depths of space, never to return.

If we could watch a comet long enough we might then expect to see it gradually wear itself out, grow a smaller and smaller tail at each return, fade away into a mere spot of hazy light, until at last perhaps even this vanished.

Measured by human chronology this process must be slow, for so far as we can judge by the evidence of the old chronicles, Halley's Comet has not lost much in brightness during the past 2000 years. But we do not have to wait to watch things happen to individual comets. There are numerous short-period comets which return to perihelion every six or eight years. These should be the spendthrifts and might be nearly worn out. As a matter of fact, not one of these comets is conspicuous and many of them seem already to have lost most if not all of their tail-forming material. One, at least, Biela's Comet, which was an easy telescopic object a century or so ago, has faded out altogether and is now quite lost, although it has returned more than once to positions where it would have been conspicuous if it had been as bright as it used to be. Among comets of the same age and year, those with short periods should wear out the fastest, while those which engage but rarely in the brilliant dissipation of a perihelion passage should be less exhausted.

A test of this has recently been made by Bobrovnikoff, a Russian astronomer now at the Lick Observatory. He has collected from various sources determinations of the brightness of 94 comets of known period, ranging from three years to several millions. Plotting these against the periods, he finds that, although the individual values scatter a good deal, the averages show a definite and unquestionable trend. The comets with long periods average the brightest and those of shortest period the faintest. This agrees so well with the results of the theory of gradual disintegration that it would almost prove it independently of the visible arguments already mentioned, and the combined evidence of the two arguments is conclusive.

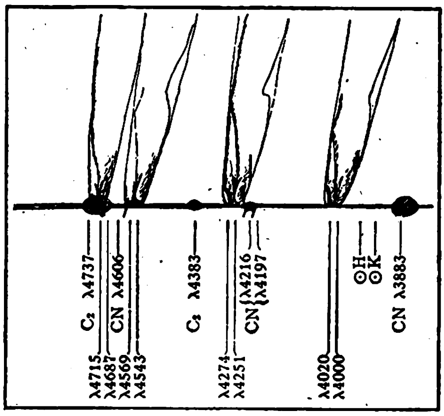
It appears, therefore, that in bygone ages the comets of our system were not merely more numerous but brighter. How rapid the process of decay is we can not be sure. Only two comets have been observed for a large number of returns, Halley's and Encke's. The first is still a fairly bright comet, although far inferior to many of those of really long period. The second is a faint object and appears to have faded by about a magnitude during the last century; that is, 30 returns. Whether a similar change has happened to Halley's Comet can hardly be determined from the rough estimates of the ancient records. Such as they are they indicate a slower decrease in brightness per return.



Even if the rate of disintegration is only one tenth as great as Encke's Comet suggests, a comet must lose about 1/300 of its luminous material at each return. As it dwindles away, the rate of loss itself should decrease, but nevertheless after 3000 returns the brightness should have diminished by ten magnitudes; which covers almost the whole range from the brightest to the faintest on record. This would make the whole life of Encke's Comet about 10,000 years and of Halley's a quarter of a million. Some of the greatest known comets, such as those of 1858 and 1811, have periods of less than 3000 years. On our tentative assumption they would fade away into insignificance in 10,000,000 years. This is a long time from most standpoints, but to the astronomer and even the geologist it is nothing at all. Our earth is certainly more than 100 times older than this.

Hence either the rate of disintegration of comets is hundreds of times slower than is indicated by such observations as exist, or else the comets which are at present in our system are far younger than the planets and have been added to the system long after the planets were established. Which alternative must we choose?

Bobrovnikoff decides definitely for the second alternative and concludes that our present comets were picked up by the solar system in some way only a few millions of years ago. Some six million or eight million years in the past our sun and its attendant planets must have passed through the great scattered cluster of hot stars which forms the constellation Orion and probably through some of the clouds of nebulosity which accompany them. In traversing such masses of diffuse matter, the combined attraction of the sun and planets might "capture" some of the nebular material and cause it to circulate in orbits about the sun. Such aggregations of matter might well be the parents of comets. In the ages since, those of short period would for the most part fade out, leaving those whose periods were long and a few of the shorter period resulting from secondary changes in their orbits at later dates in their careers.



Courtesy Publications of the Astronomical Society of the Pacific

SPECTRUM OF HALLEY'S COMET

At left is the spectrogram and, above, a diagram of it. Vertical streamers are open slit spectral images of the tail. Figures show wavelengths. Cyanogen (CN) bands are in the head but not the tail. From a paper by Bobrovnikoff

The result million of years later might be a cometary system roughly resembling ours. Whether the resemblance would be satisfactory in detail can not be settled until a good deal more work has been done, especially in the way of calculating whether comets picked up in this way would ultimately be spread about the sun almost uniformly in all directions as the comets actually are. But in any event the hypothesis is stimulating and its further developments will be awaited with much interest.

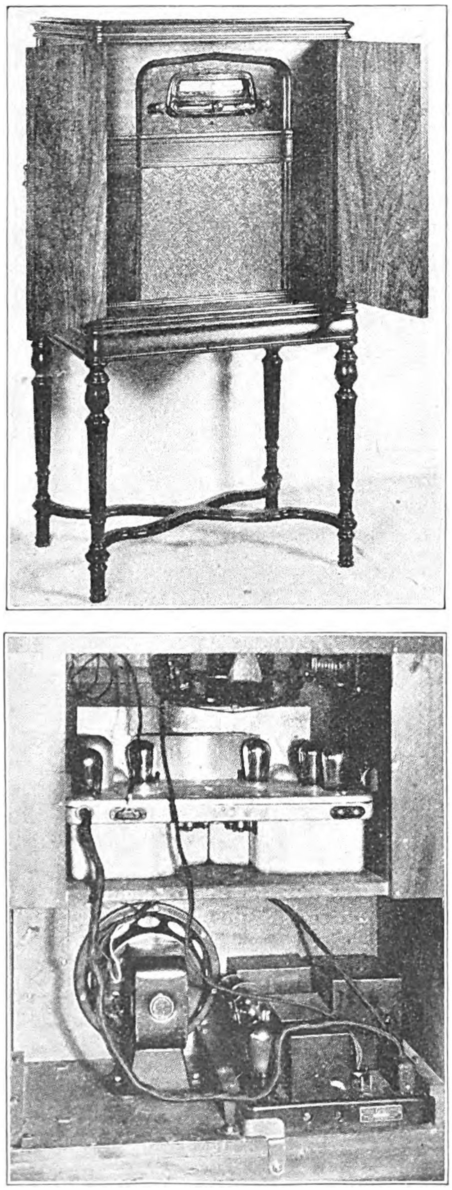
Radio in 1930

Regardless of New Circuits, Tubes, and the Like, the Final Test of a Set Is Its Tone Quality

By HOWARD T. CERVANTES*

EACH radio season is ushered in with a new collection of terms and catch-phrases to intrigue the prospective radio-set purchaser. While it would appear from a glance at the radio advertising that there had been a great many startling developments, it frequently becomes apparent after the season is well under way that there have been only one or two important innovations.

This season we are confronted with such terms as "screen-grid," "linear detection," "band pass filter," and countless other terms and phrases which hold no meaning for the layman.



VICTOR

Above: Exterior of the R-52 radio set only. *Below:* Interior view of the RE-45 combination radio and electric phonograph

> THE layman considering the purchase of a new radio set is confronted with a bewildering array of claims made by various manufacturers regarding the outstanding features of their particular receivers. How is he to select the one which will give him the greatest satisfaction? In the accompanying survey of the situation, the author points out the standardization that has come about in the radio field, and plainly indicates that the choice is largely a matter of the price that one can afford to pay, and the style of "furniture" that one desires to surround his set. One's taste in tone will indicate the set in any price class that will please the purchaser.
>
> —*The Editor.*

After all, the final test of any radio receiver is what comes out of the loudspeaker. The average man, when he comes to select a radio set, judges it more on this basis than on anything that he has heard or read concerning it. In many instances he requires a private demonstration of the set in his own home where he can operate it under actual working conditions in the location where it is to be used. If the quality of reception does not come up to his expectations, the mere fact that the set uses screen-grid tubes or has linear detection or any other feature will not induce him to buy.

IN reviewing this season's radio sets, we find that the greatest strides have been made in the improved quality of tone and fidelity of reproduction. In fact, a point has been reached where it is a difficult matter to note any marked difference in the reproduction of sets ranging in the same price class. In this respect it would be interesting to witness a radio blindfold test, using a dozen or so of the leading radio sets of different manufacture similarly priced. It is safe to predict that the result of such a test would show that the majority of people who are incapable of splitting hairs on musical harmonics, and to whom overtones and undertones go unnoticed, would be unable to make an honest distinction between them.

While the great majority of manufacturers are featuring sets using screen-grid tubes, not all of the improved tone quality can be attributed to the use of this new tube. A power tube which has recently come into use, and the progress that has been made in dynamic speaker design, have contributed largely to the better reproduction evident in this year's receivers.

SOME credit must also be given to the broadcasting stations for their higher quality of transmission which has reached a state of perfection undreamed of a few years ago.

Although the present furore over the screen-grid tube would seem to indicate that its application has revolutionized radio over night, we have two prominent manufacturers who are continuing to use the standard type of A. C. tube in their latest productions.

The Victor Talking Machine Company is featuring "micro-synchronous" reception in its latest models. This term is derived from the method employed for securing resonance between various circuits, which, it is claimed, insures a high degree of sensitivity and selectivity. The tuning arrangement used in these sets is quite unusual, consisting of a lever which operates over a full-vision illuminated scale. A space is provided at the top of this scale for marking in station locations. Close adjustment is secured by turning a small knob at the end of this lever.

ZENITH

The remote-control unit is shown. A built-in loop aerial and electric phonograph pick-up connection are incorporated

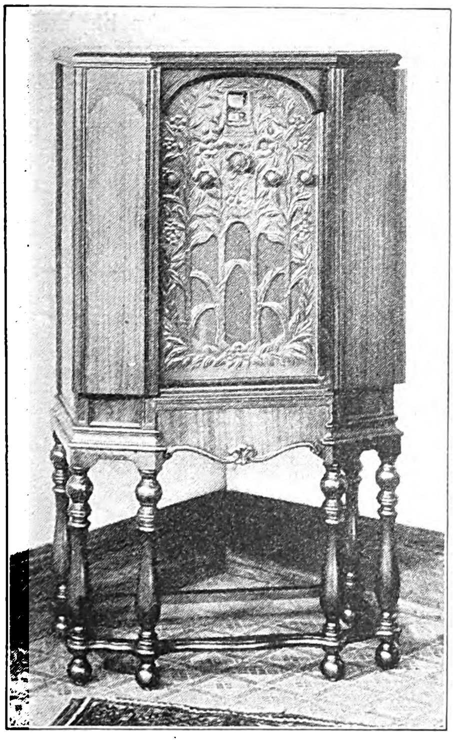
Another interesting feature of the Victor sets is the "harmonic modulator," a device for regulating the degree of emphasis to suit the acoustics of the particular room in which the set is located. The Victor company is one of the prominent manufacturers previously mentioned who have not gone in for screen-grid tubes.

---

*Vice-President, Haynes-Griffin, Inc., New York City

We find another notable exception to the use of screen-grid tubes in the new Majestic sets. It will be remembered that last year's Majestic models met with unprecedented success due, in the main, to the fact that this was the first time that a low-priced, high-quality receiver using a built-in dynamic speaker was offered to the public. Several minor changes have been made in the new Majestic sets and they are claimed to exceed in sensitivity, selectivity, and tone quality the models of the previous year. Improvements have also been made in the Majestic dynamic loudspeaker. The entire elimination of hum is another feature being stressed by the manufacturer of these sets.

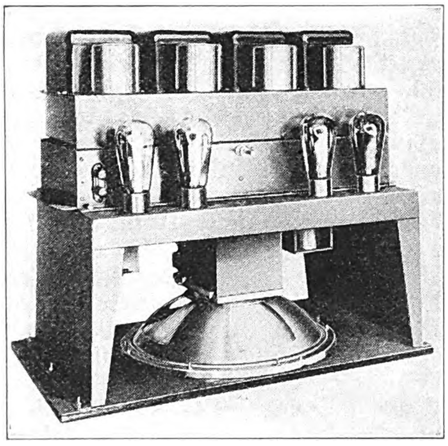
THE one indisputable fact regarding this year's models is that the purchaser is given greater value for his money than at any time in the past. Any number of manufacturers are marketing sets in console cabinets with dynamic speaker and screen-grid tubes, together with other improvements, priced around 150 dollars. When we get above this figure we find more elaborate cabinets, automatic tuning, remote control, and other features that increase the manufacturer's cost of production. This cost is finally passed along to those who are more exacting in their tastes and requirements. For example, the "tired business man" will have one of the new remote-control receivers which he may adjust without leaving his easy chair, or he may have the control box on a table beside his bed, enabling him to start, stop, or tune the set without getting up. For that matter, the control box may be installed in any room in the house and the radio set proper located in any other room desired.



STROMBERG-CARLSON

The automatic control in this Model 846 tends to overcome the effects of fading

We have a set embodying this feature in the latest model by Kolster. This set is furnished with a long cable at the end of which is a small control box resembling very much the push-button type of control for inter-communicating telephones. Ten push buttons are provided on the top of this box, one to start, one to stop, and eight others which, when pressed, operate the mechanism which tunes in the desired station. When the "start" button is pressed, a small red pilot light indicates that the set is functioning. When any of the selector buttons are pressed, a green light shows, indicating that the station selected is being tuned in. A small knob is also provided for regulating the volume of the loudspeaker.

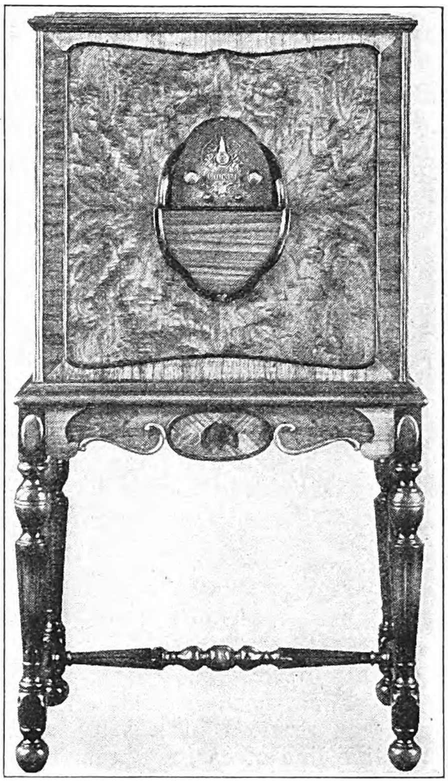


COLONIAL CHASSIS

The Cutting dynamic speaker is shown mounted with the opening pointing down

Zenith is also marketing a new set with remote-control features. It is possible, with this set, to use several control stations located in various parts of the home. For example, one of these controls may be installed in the bedroom, another in the dining room, and perhaps one in the den. The radio set may be located in another room, or if it is desired, it may be concealed in a closet. Adjustment of the set is accomplished from any of the points at which the control stations are located.

In addition to the remote-control receiver, Zenith is continuing to produce a line of improved automatic receivers superseding those which proved so popular last year. Screen-grid tubes and other new developments in receiver design have been incorporated in these new sets. Push buttons are furnished in addition to the usual tuning dial and it is only necessary to press one of these buttons to tune in any desired program. If the operator desires to tune in stations other than those that have been set for automatic tuning, he uses the conventional type of tuning dial which is also included in this set.



COLONIAL

Model 32, shown with the "secret" panel opened to disclose the control panel

Another development designed to facilitate adjustment is that of visual tuning employed in the new Stromberg-Carlson Model 846. Visual tuning is accomplished by means of a small meter located on the panel above the main tuning dial. A pointer moves across the face of this meter when the dial knob is rotated. The proper point of adjustment is indicated for any particular station when the pointer is at maximum deflection on the dial scale.

A FEATURE in connection with this method of tuning is what is known as a "silent" knob, which, when depressed, disconnects the loudspeaker while the tuning dial is being rotated. The pressure on the knob is released when the desired number on the dial is reached and the pointer is at maximum deflection. This permits the operator to tune by sight rather than by ear and does away with the necessity of listening to annoying noises and "blasting" of other stations while the dial is being rotated.

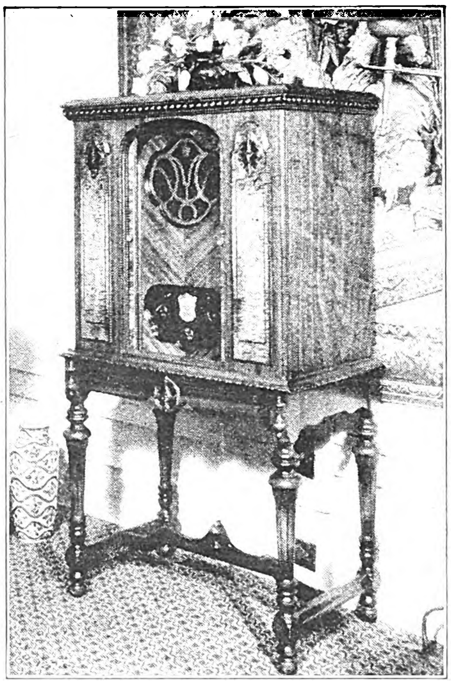
Another feature of this set worthy of mention is the fact that the circuit employed compensates for any variation in signal strength and results in uniform volume almost regardless of fading effects.

The new Atwater Kent models are characterized, as in the past, by their compactness and low price. Two new models have been introduced using the screen-grid tubes. The Model 55 employs two of these tubes and the Model 60 three. The Model 60 is intended for use in locations where it is necessary to depend on reception from distant stations. This accounts for the additional tube which makes for greater sensitivity. An Atwater Kent set for use in D. C. districts, using the screen-grid tubes, is also available. All of these sets are equipped with a local-distance switch. The function of this switch when in one position is to cut down sensitivity for local reception and when in the other position to increase sensitivity for distance reception.

THE Atwater Kent company has this year designated several cabinet companies to manufacture consoles expressly for the Atwater Kent chassis and dynamic speaker. This arrangement has resulted in a varied and attractive line of cabinets, making it a simple matter to select a console in proper taste with the style of the furniture in the particular room where the set is to be located.

In the new Colonial sets emphasis is being laid on the Cutting dynamic speaker. Colonial has departed from the usual custom of mounting a loudspeaker on the front panel of the cabinet and has located the speaker at the base so that the sound comes from the bottom of the cabinet. This method is claimed to be much more satisfactory and is likened to indirect lighting, in that the sound is not thrown directly out, but is reflected from the floor in the same way that light is reflected from the ceiling. It is said that a greater realism of tone is obtained with this system.

Locating the speaker at the base of the cabinet has made it possible to do away with the necessity of a speaker grill on the front of the cabinet. No doors are in evidence on the Colonial sets, the tuning controls being accessible when a small panel, pressed at one end, raises up and slides into the cabinet out of sight. Screen-grid tubes are used in all of the new Colonial models.



ATWATER KENT
The sensitive and selective Model 60 in a special cabinet with built-in loudspeaker

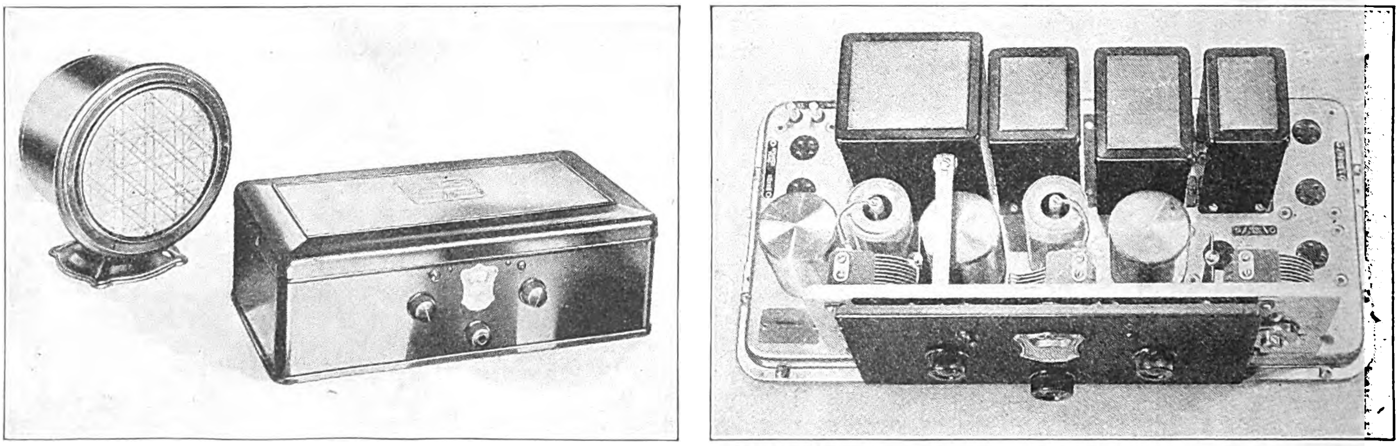
There is no question but that the average unit price on the complete set has been dropping rapidly during the past two years and probably the outstanding price development in manufacturers' merchandising plans for the present year is the large number of sets retailing between 100 dollars and 150 dollars. The majority of these sets are built in small consoles, many of them using the screen-grid tube and all equipped with dynamic speakers.

There are probably 15 or more manufacturers fighting tooth and nail in this highly competitive price class. Obviously large volume is necessary to build profitably at this price and it is equally true that not all of these manufacturers can by any means secure the volume of sales which is necessary. Consequently, several of these manufacturers will probably retire from the field this year or be obliged to seek mergers with their competitors. Evidence of this latter development is already at hand. Some mergers have already been accomplished and radio trade papers are filled with rumors of many more.

Coming into the field this year in a big way, as manufacturers of complete radio sets, are several companies which have heretofore made products which were accessories to the battery set. We find the National Carbon Company in the field with a complete line of Eveready electric receivers, and the Philadelphia Diamond Battery Company with the Philco line of radio sets. The American Bosch Magneto Company is also making a strong play in the medium-price field.

AS indicated in the early part of this article, manufacturers are striving desperately to create the impression that the new models are a distinct advance over sets that have been heretofore available. It is true, nevertheless, that for the first time in radio history it is difficult for the average listener to distinguish between the new sets and those that were available a year ago. This is the best evidence of the stabilization that is making itself evident in the radio industry and purchasers of well-designed sets manufactured in 1928 are today practically as well off as the owner of any of the latest models.

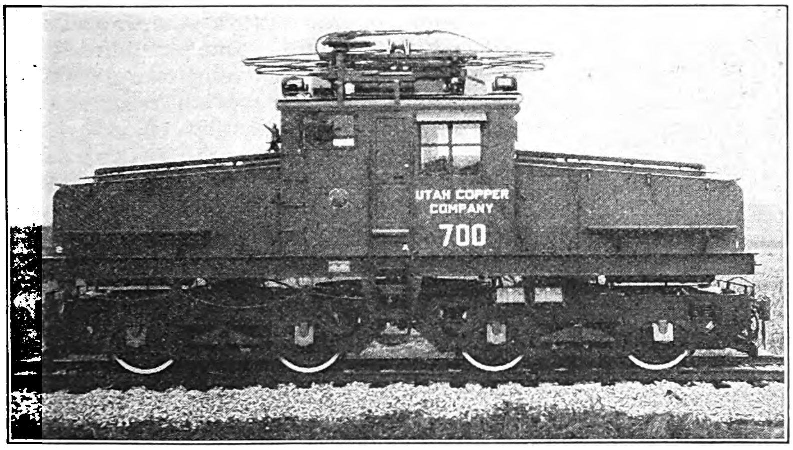
Whereas hundreds of thousands of electric sets were sold last year, it is generally believed that the big swing from battery sets to electric sets will take place in 1930 and that consequently more dollars per capita will be spent by the public for radio in the next six months than in any corresponding period in the history of the art.



TWO OTHER MODELS

The Atwater Kent Model 60, shown in a cabinet at the top of the page, is illustrated in a table model at the left above. At the right is an interior view of the Model 55 showing the arrangement of the parts. Note the screen-grid tubes in their metal shield cans

Largest Electrified Metal Mine



COMBINATION TROLLEY-BATTERY LOCOMOTIVE

Seventy-five ton electric locomotive designed for operation either from a trolley at 750 volts or from a 230-volt storage battery. Note folded trolley

WITH A TRAIN OF COPPER ORE

Front view of the first of the special locomotives drawing power from a trolley wire and pulling a heavy load

THE Bingham, Utah, mining properties of the Utah Copper Company can now claim the distinction of being the world's largest electrified metal mine. The electrification of the haulage system of this mine, starting on a large scale early in 1928, has now progressed to a point where the electric equipment involved is the most complete and up-to-date of any metal mining project.

Although the actual mining operations had already been electrified, the haulage system had, up to the middle of 1928, been of the steam type. A trial locomotive was built by the General Electric Company and was found satisfactory in service. Plans were then made for the installation of 20, more than half of which are now in service, and finally, for an additional 20 for use as soon as they can be built and delivered. It is expected that possibly a few in addition to this number will be required to complete the haulage program. Thus this mine will have in use by far the largest number of electric locomotives ever applied to an open-cut mining operation.

The copper ore is found on both sides of the canyon in which the town of Bingham is situated. Giant electric shovels working on successive terraces cut in the mountain face, remove the overburden which covers the ore, and then the ore itself. The overburden is deposited in cars which are hauled away by the electric locomotives and dumped down another side of the mountain, while the ore itself is hauled in cars to the mills at Magna, 17 miles distant.

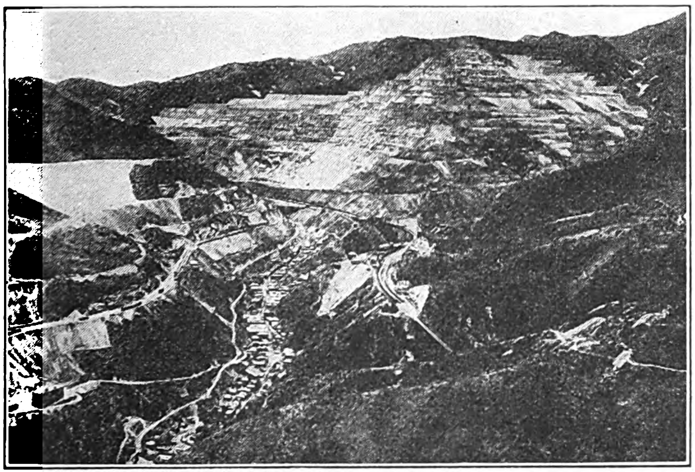
All the locomotives are specially designed for this service and weigh 75 tons each. Seven of the 41 involved are a combination type particularly valuable for operation where power cannot always be obtained from the usual overhead system. Each unit has facilities for overhead collection of current, side-arm collection, or for operation by means of storage batteries. In addition, the 41 locomotives are each equipped with a cable reel collector by means of which power can be delivered to the locomotive over a considerable distance from the supply point by means of a trailing cable.

Power for this haulage system will be supplied from a number of substations, two of which are already in use, and an extensive electrification system is necessary for distributing the power. The electric locomotives haul the ore cars up the side of the mountain by means of switchbacks over the various benches to the shovels. There the cars are loaded and hauled back down to the foot of the mountain, where they are made up into long trains and transported to the mill over the Bingham and Garfield Railroad.

Four large totally-enclosed motors, controlled by a single-unit, three-speed system, drive each locomotive.

THE COMPANY'S RAILROAD

Portion of the Utah Copper Company's railroad, showing the town. In the center background is a large inclined cable elevator



Photographs Courtesy General Electric Company

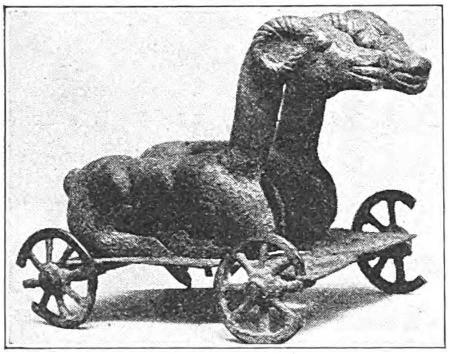
LONGEST TOWN IN THE WORLD

Bingham, Utah, reputed to be the longest of its size in the world, consists of a single street in a valley. Terraced hillside is the mine

From the Archeologist's Notebook

Scythian Bronzes

THE Scythians were a group of warlike Iranian tribes mixed with Mongolians that over-ran southern Russia and southern Siberia. Greek influence was not able to kill the virile Scythian style which, even when elaborated, remains purely Asiatic. The problem of the Scythian bronzes is a very difficult one and museums seek eagerly for them. The Metropolitan Museum of Art has many examples of them dating from the 3rd and 4th Century A.D. We illustrate two of them, first, a kneeling deer in bronze and second a pair of rams kneeling on a little cart. Both rams and cart are of silver which, like gold, is rare among the "Scythian" finds which came from China and Siberia because of early and thorough plundering. The significance of the kneeling animals is not clear but it has been suggested that they represent animals already slaughtered and ready for the sacrifices. Archeology affords endless opportunities for study.



SCYTHIAN SILVER RAMS
Owing to plundering, articles of Scythian origin in gold and silver are rarely found

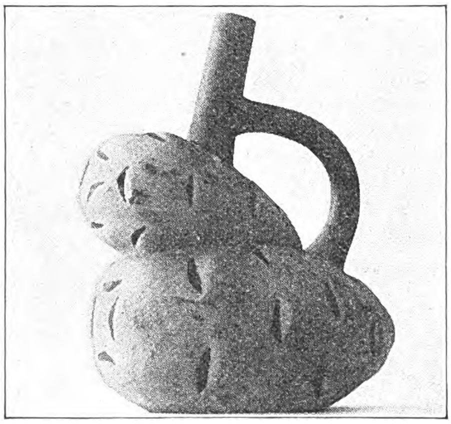
Primitive Art Solves the Secrets of Food Distribution

SCIENTISTS are solving the problem of when and where various food plants were first cultivated. The origin of many is now definitely known, according to researchers on the staff of the Field Museum of Natural History; others are still in dispute. How some of these problems are solved is illustrated by exhibits at Field Museum. For example, in the last few years scientists have established, through the unearthing of some very ancient pottery on the coast of Peru, that certain plants are indigenous to the American continents, and not the result of importation by the European settlers. These pots, made many centuries before the discovery of America by the white man, are modeled in the shapes of various plants, and thus prove that those plants were grown on this side of the world in those early days, according to Dr. William M. McGovern, former assistant curator of South American and Mexican ethnology at the museum.

Among the plants which the Field Museum collection proves are indigenous to America are peanuts, maize, squashes, pumpkins, beans, potatoes, and the poisonous tuber called mandioka from which tapioca is made. All of these have been used as models for the shape or the decorations of the pottery. From other sources, it is known that pineapples, tobacco, tomatoes, chocolate, and coca from which cocaine is made, originated in the Americas. On the other hand, watermelon, believed by most people to be a 100 percent American product of our southern states, apparently originated thousands of years ago in Africa, says Dr. McGovern, for remains of watermelons and their seeds have been discovered in tombs of ancient Egypt.

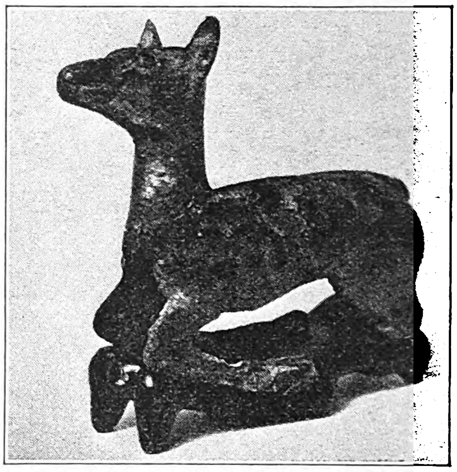
The "False Pyramid" of Medum

THE Museum of the University of Pennsylvania has received permission from the Egyptian Government to carry on archeological work at Medum in Egypt and has organized an expedition which began excavation on that site in November. The expedition will be under the leadership of Alan Rowe, says Director Jayne, and will be conducted under the auspices of the Eckley Brinton Coxe, Jr. Foundation, which was established for the support of the Egyptian Section of the University Museum and for the furtherance of field work in Egypt. Mr. Rowe has been serving since 1925 as field director of the University Museum's expedition to Beisan in Palestine. With the organization of the new Egyptian expedition, however, the work at Beisan in which the museum has been engaged for seven years will be temporarily suspended.



POTATO-SHAPED POTTERY
Archeology helps to clear up the true origins of food plants in foreign climes

Medum lies in the Libyan desert, roughly between the northern end of the Fayyum and the River Nile, some 50-odd miles south of Cairo, and is a site which offers great possibilities not only for fresh contributions to existing knowledge in Egyptian research but also for the collection of interesting and valuable material. To the north of Medum and in the following order from south to north lie the Ancient and Middle Empire pyramid sites of Lisht, Dahshur, Sakkara, Abusir, Zawiet-el-Aryan, Gizah, and Abu Roash, while to the south are the Middle Empire pyramid sites of Illahun and Hawara. All these sites really form one continuous royal cemetery nearly 60 miles in length on the western side of the Nile.



A KNEELING BRONZE DEER
An example of Scythian art in bronze dating from the 3rd or 4th Century A. D.

In its work at Medum, which is believed to be chiefly a Fourth Dynasty site dating onwards from about 2930 B.C., the University Museum expedition will concentrate on the excavation of a pyramid called by the Arabs "El-Haram el-Kaddab," or the "false pyramid," and described in a report from Mr. Rowe as the most important structure visible on the site.

"The 'false pyramid,' " Mr. Rowe's report states, "is of three, originally seven, square receding stories which, according to Professor George Steindorff, of Leipzig, rise to a height of 214 feet 8 inches in steep stages. The first story is 81 feet 6 inches high, the second 98 feet 11 inches, and the third, now almost destroyed, is 34 feet 3 inches high.

"Professor W. M. Flinders Petrie, of the British School of Archeology, points out that the pyramid was built cumulatively, 'that is to say, in seven successive coats each of which bore a finished dressed face' around a central mastabah tomb. He states that the stepped stories were originally filled out."

Early Man in North Arabia

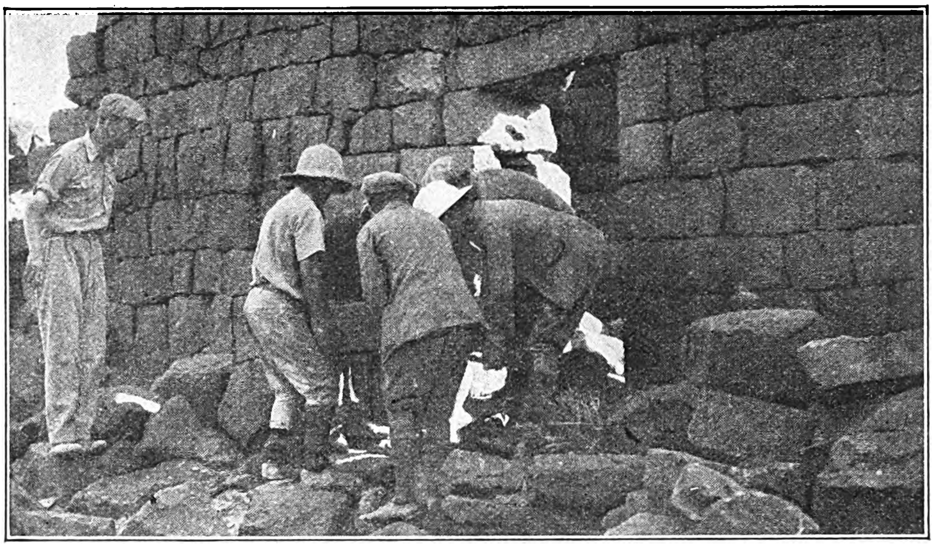
By HENRY FIELD

Leader of the Captain Marshall Field North Arabian Desert Expedition

THE Captain Marshall Field North Arabian Desert Expedition, under the leadership of the writer (assistant curator of the Field Museum of Natural History, Chicago), covered thousands of miles between Bagdad and the Hejaz railway in search of archeological information. Many thousands of years ago this desert was fertile and well watered and able to support a semi-nomadic population. Thousands of flint implements, scattered over the desert, prove the existence of primitive man in various prehistoric phases of culture.

The two photographs show fortresses built by Roman legions for protection from Bedouin marauders. Qasr Azrak was visited by the expedition to make plans, drawings, and photographs of the buildings. The upper photograph shows myself directing the work of removing a door-lintel inscribed in Greek characters, which may give the date of the Roman occupation of Qasr Burqa, the most eastern outpost of the Roman Empire. Qasr Burqa stands today more than 100 miles from wells containing water, although in the rainy season there is often water in the reservoir built by the Roman legions. Much valuable archeological data was collected; thousands of photographs of the various sites visited, and of the modern Bedouins, were obtained. In fact a whole new light has been thrown on the early history of the North Arabian desert, and the results suggest that this area may have lain, in prehistoric times, on one of the main lines of migration between east and west.

It is now possible to state with absolute certainty that man in a prehistoric phase of culture inhabited this North Arabian or Syrian Desert over a long period of time.



HENRY FIELD AND PARTY EXPLORING QASR AZRAK

Removing a lintel inscribed in Greek characters from a building which was located at the most eastern outpost of the Roman Empire. North Arabia, once fertile, is now a desert

AN ANCIENT ROMAN STRONGHOLD

The fortress of Qasr Azrak was built by Roman legions to defend the Empire against Bedouin marauders. It was on one of the main lines of migration between the east and west

Marble Sculpture and the Ultra-violet Ray

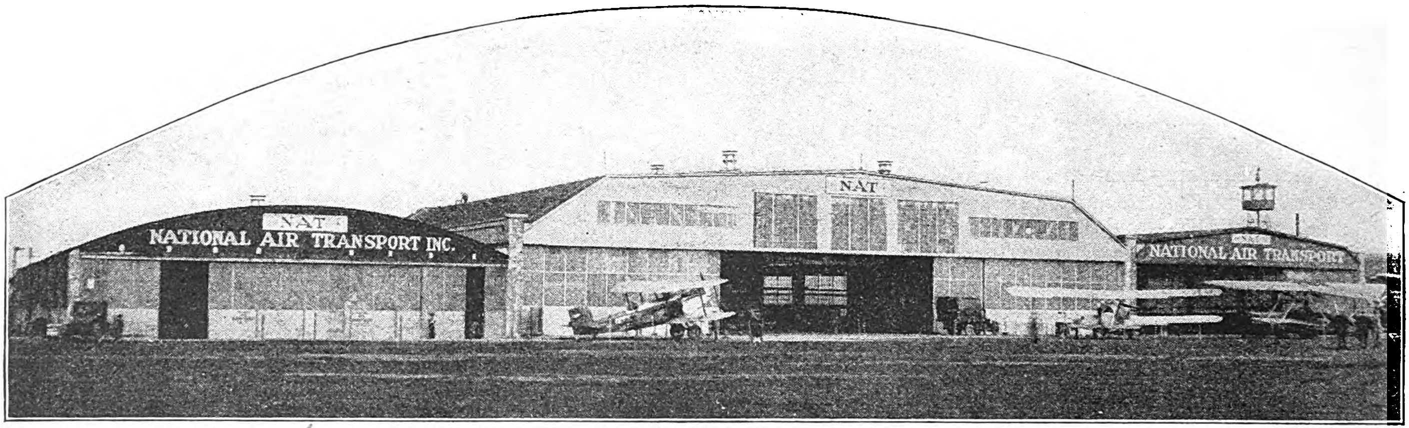
THE invisible ultra-violet rays are at the cold end of the solar spectrum. When objects are exposed to this light they tend in varying degrees either to fluoresce or to reflect the rays. In the case of fluorescence, substances which under normal conditions are white might appear yellow, blue, or any other color when exposed to ultra-violet light.

Perhaps no works of art through the ages have been so sought for and cherished as fine marble sculptures. The temptation to produce forgeries, to copy, or to repair has attracted skilful artists and artisans. For this reason, in the study of the physical characteristics of museum exhibits, no material seemed to offer more interesting possibilities than marble.

With continued exposure to the elements, the surface of marble is changed, and gradually, because of penetration from the surface, chemical action proceeds a short distance into the body of the marble. We might, therefore, expect that the appearance of old marble under the ultra-violet ray would be different from that of freshly cut marble (or old marble which has been re-cut), the surface of which has not been changed by chemical action, and this, in fact, has been demonstrated by experiments.

After additional preliminary experimental work with marbles of various periods, a group of test examples was submitted. In all cases the conclusions based on the use of the ultra-violet light were identical with those which had already been reached either on external evidence or by reasons of style. Both old and new pieces were submitted without any information whatsoever concerning the age of the specimens. Examined under the ultra-violet rays, the genuine pieces were readily distinguished from those which were more modern than they purported to be. The Little Maiden by Dossena, a marble statuette in the archaistic Roman style (see the SCIENTIFIC AMERICAN for October, 1929), although its surface had been altered by baking the marble and then pitting it with a ragged stone, was shown by the test to have been made from recently cut marble. In addition, the three portions into which the sculpture had been broken were found to be part of the same piece of marble.

As with all new things, possibilities of which have not been throughly probed, it may be supposed that the ultra-violet light will be a panacea for all troubles. But just as with the X ray, it requires a wide experience with varying cases, and no less careful judgment. Our experiments show that the ultra-violet rays will be of very great assistance in establishing the age of marble. That the ultra-violet rays have possibilities which are not limited to this field alone we are learning from our studies.—*James J. Rorimer, of the Staff of the Metropolitan Museum of Art.*



Central Building of This Group at the Chicago Municipal Airport is One of the Largest Clear-Span Hangars

Insuring Safety on Airlines

Behind the Pilot Is a Far-Reaching Organization, Every Member of Which Is Working for the Good of the Service

By LESTER D. SEYMOUR
General Manager, National Air Transport

OPERATING an air line has a fascination akin to any human endeavor requiring the co-ordination of a large number of separate functions to attain a particular objective. As these operations increase, the separate efforts of a large number of people become increasingly important. Perhaps no better illustration of what I have in mind may be had than from the following quotation taken from an issue of the N. A. T. *Fly Paper:*

"*Airman.* What a word to inspire the imagination! A dream of centuries come true, resulting in a people that may be described by such a magic word. Not all may fly, but as truly as the lowliest private and the greatest general are both described by the word soldier, so may the dirtiest 'grease monkey' and the greatest pilot be termed airmen.

"Over the Alleghenies on the blackest night, through blinding fog as the mail roars on its way, it is accompanied and guided by the hand and brain of an airman. On an ice-covered field, in the blast of a zero wind, a fleet messenger of the air is being fueled. Guarding each gallon from the elements that the engine may have but the cleanest of gas, testing each plug that no chance of failure may remain to endanger a life at stake, you find a man who perhaps never flies but is nevertheless just as truly an airman.

"Some are in cockpits; some at the gas pumps; others at a bench; some making a weather map; some pushing ships into shelter; others with no specific task more important than to help wherever they can—all airmen."

Air transport lines, being only another type of scheduled transportation, have discovered that they may look to the history of the railroads for precedent in many ways. Except for differences in equipment the problems of the railroad and the well organized air transport line are much the same. Both depend to a large extent on that intangible but extremely important thing called *esprit de corps.*

In air transport work particularly it is essential that every man, in whatever capacity, realize the importance and relation of his particular job to the entire task. This may be because of greater speeds involved, the smaller independent units, and because a failure of motive power may be more serious when a vehicle moves in two dimensions rather than in only one. The comparatively fragile nature of aircraft and the conditions under which they must operate have much to do with the situation.

PERSONNEL employed in the operation of an airline require a greater average of skill than in other modes of transportation for the same reasons. This has been one reason for air transportation offering such great opportunities to specialists.

Certain positions of trust in an air transport line, however, seem to demand many widely varying abilities in one individual. It has been said that a man who attempts to be a jack of all trades is a master of none. On the exception to this proverb rests the success of the air transport pilot. In flying on schedule through all kinds of weather, the actual manipulation of the controls of the airplane is the least of the pilot's worries. That ability is something that he has attained and long since taken for granted somewhere back in his early flying experience. In addition, he must at the same time exercise no mean ability as a meteorologist, aerologist, and weather forecaster. He must also continuously function similarly to the navigator of a ship on the sea, and in some instances operate a radio transmitter. These duties require perfect co-ordination of brain and hand.

The pilot has no little responsibility. He must not only complete his schedule on time but complete it safely. He has in his control an airplane which cost his employers many thousands of dollars.

The value of his cargo is difficult even to guess. If it happens to be passengers, he is responsible for one to fifteen lives. If his cargo is inanimate, mail or express, it may have any intrinsic value from zero to a huge sum according to the contents of the letters and packages. In either case he can only know that his responsibility for getting the cargo to its destination is too great for him to calculate. It has been said that the responsibilities and duties of such a pilot combine those of the captain, navigator, and chief engineer of a ship, the locomotive engineer, train dispatcher, and railroad conductor.

Leaving for the moment the actual task of flying the airplane, duties equally important devolve on the ground organization. It has been truly said by one of our pioneers "that there is more to aviation than flying." For every airplane in the air someone, somewhere on the ground, must have made sure that every bolt, nut, and turn-buckle is tight and in its proper place; that every piece of metal and fabric is of proper strength and in perfect condition, and that every engine and instrument is more than capable of its task.

Even the man whose duty is no more difficult than filling the fuel tanks has the responsibility of being sure that the tanks are really full, that the gasoline is clean and that his job is done at a time which will not interfere with the schedule or other work which the airplane may require in servicing.

Somewhere another man must be responsible for the collection and transmittal of accurate weather information, and another that it gets to the pilot when he needs it. Other men must be sure that the radio, whose beam the pilot follows through the clouds and fog, is kept operating and that the weather broadcast is accurate and ready at the exact time the pilot expects or needs it. He must further hold himself in readiness for the transmission of any emergency messages that may be necessary. A little incident will serve to show the necessity of quick action with the radio.

One of the N. A. T. pilots left Bellefonte, Pennsylvania, eastbound with the mail in fog so thick that it was impossible for him to see more than his lighted instrument board before him. He "took off," however, with the knowledge that at Hadley Airport, his destination, there was some 1500 feet of "ceiling."

PERIODICALLY along his journey eastward he was informed of weather changes as they took place. However, when he actually reached the field and flew over it, a sudden change of which he had not been informed had taken place since the last weather broadcast. As his ship went roaring across the field, which he could not see although he knew that he was over it, he found that the 1500-foot ceiling had disappeared.

He had no way of knowing whether the fog extended all the way to the ground or whether it might be clear underneath for a few hundred feet which would permit him to descend safely. With the ship roaring overhead, the field manager sensed the situation and rushed to the radio room of the Weather Bureau where he advised the pilot that there was still approximately 300 feet below the fog. The pilot turned back, came safely down through the clouds, and landed. Only a sense of responsibility, knowledge of what to do, and doing it quickly brought the mail in on time and perhaps averted a disaster.

The actual organization of an air transport line varies with different companies. They have, however, certain more or less definite points in common. At each field along the line a crew of service mechanics responsible to a field manager is stationed. The field managers are responsible to a division superintendent stationed at some central point on the line from which flying activities are directed.

If the line is sufficiently long to warrant two or more divisions, then the division superintendents are responsible to an operations manager. If not, the division superintendent himself usually serves as operations manager responsible only to the general manager or operating head of the company. The pilots who fly the line are also responsible to the division superintendent or operations manager. Major overhaul and repair of the airplanes and engines is in most instances separated from service repairs and operated as an independent unit.

Airplanes and engines are periodically taken out of active service and put through this overhaul shop before being put back onto the line to replace others which in turn are taken off for their periodic overhaul. The shop mechanics are responsible to a shop superintendent who may either be responsible in turn to the manager of operations or to the general manager independently as the case may be.

INSPECTION

Every plane on the N. A. T. lines is carefully inspected by competent mechanics before a scheduled flight

Such functions as engineering, accounting, publicity, advertising, and traffic are usually separate departments of the company responsible directly to the general manager. They serve as advisory and complimentary services to the actual flying.

Experience seems to indicate that airplanes may now be continuously flown a distance as great as 2000 miles between complete inspections and that complete overhaul may be required in the neighborhood of every 1000 or 1200 hours. An engine whose life may be estimated at 300 to 1500 hours is now expected to run from 250 to 300 hours between major overhauls. Of course, minor repairs and daily service are required on both airplanes and engines as the result of the rigid daily inspection.

The weather service, which plays such a large part in modern scheduled air transport, is operated either by the government or by the lines themselves when the governmental service is not available. In either case this service consists of the collection of weather information along the line and some distance on each side of it at intervals of from two to four hours, and the dissemination of such information to proper stations along the route.

Data so collected, together with general weather maps and weather information furnished by the government, are made use of by the pilots in judging whether to fly through or over certain storms and atmospheric disturbances, and what may be their chances of getting through.

The information is disseminated by land wire telegraph and telephone and radio telegraph and telephone. Like railroad trains, the airplanes are dispatched and kept track of along the line from a central operating point.

THE pilot usually flies from three to five hours on consecutive days with one and in some cases two days off for rest between trips. Those who think that the pilot's life is an easy one because he has so much time off need only follow him for a few weeks to discover that under certain circumstances he does as much work on one trip as most people do in a good many days.

The pilot's discipline is in most instances none the less rigid because self imposed. He knows that he must keep in the best condition in order to be equal to his task. In itself it places rather definite restrictions on one's mode of life. Every pilot is ambitious to complete on schedule that portion of the route assigned to him.

The traditions of the service handed down from the days when equipment would permit of nothing like the present regularity are such that if it is humanly possible the trip is completed. No other urge is necessary. The pilot's pride is in the success which his company makes of the route, and he knows that when he is in the air he has it in his power to alter this record in proportion to how well he does his job. He is always endeavoring to do it a little bit better than someone else might do it under the same circumstances.

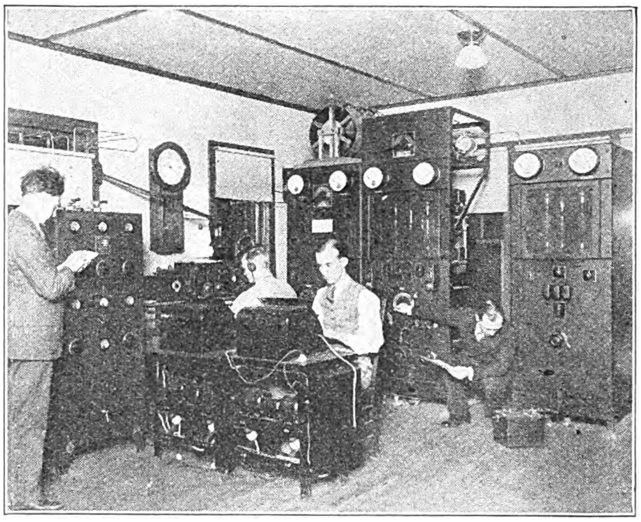
On air transport lines various methods are employed to pay the personnel. Pilots receive in some cases a fixed monthly salary of from 300 to 500 dollars or more. On other lines they receive a base salary of from 1600 to 2400 dollars a year, plus from five to ten cents a mile, depending upon the route they fly and whether it is day or night flying.

MECHANICS are paid either on an hourly or weekly basis. They receive from 35 to 40 dollars a week and upward according to their skill. Helpers receive from 25 to 30 dollars and upward in proportion to their skill and progress toward a full mechanic's rating.

The schedules on air transport lines are maintained in proportion to the effort and vigor with which those charged with flying the route accomplish their purpose within the limitations placed by weather and natural obstacles. At the present state of development it is still true that a graph showing the year's operations clearly indicates the effect of the seasons. Efficiency of operations falls off somewhat in the winter and mounts in the summer.

Fortunately, airplanes are growing better. Aids to navigation are growing more numerous and the discrepancy between summer and winter operations efficiency is decreasing. A graph showing the regularity of keeping to schedule on one line was made covering a year's period and compared with a similar graph showing weather conditions over the same period. Except for differences in scale, these two curves were almost identical. Undue delay, or failure to fly the route as a result of poor equipment or poor maintenance, have been very nearly eliminated.

On the line between Chicago and New York, flying has been carried out with nearly 100 percent efficiency all during the summer months. In a three-months period the average flying time between terminals has been less than schedule. Only a fraction of 1 percent of the trips has been defaulted and these were entirely due to weather conditions. This experience is not unusual and should be expected of any well operated line equipped with proper aircraft and assuming average weather conditions.


GOVERNMENT RADIO BEACON AND BROADCAST STATION

In the past few years concentrated effort to develop aids to air navigation, particularly for use at night and under conditions of poor visibility, have resulted in much improvement. The radio beacon, or radio range as it is technically called, has been put to work. By means of especially designed radio equipment, pilots now follow it between Cleveland and New York over the lines of N. A. T. Although it is invisible to the eye, it affords a definite roadway for the sky traveler like the ribbon of concrete for the automobile on the ground.

Powerful light beacons have also been developed and placed at frequent intervals along the routes, to aid the aviator at night. These lighthouses of the air consist of large rotating searchlights whose rays may be seen on the horizon for distances up to 50 miles or more on a clear night. Because few nights are clear, these beacons are placed in most instances as close as ten miles apart.

THESE beacons are guarded as carefully as the lights which guide the ships along our coasts. The traditions of the light keeper who lives year after year on the rockbound coast with only an ambition never to let his light fail are no more exacting than the duty which keeps the caretaker on the job to see that the airway beacon is always lighted and functioning properly. These beacons, like lighthouses, are under the jurisdiction of the United States Government. Incidentally, they are under the supervision of the same office, the United States Bureau of Lighthouses.

Likewise, the Weather Bureau of the United States has come to the assistance of this newest means of transportation, and is giving invaluable assistance from a multitude of new stations. Their duty is to collect and disseminate weather information specifically prepared to be of the most value to everyone who travels by air.

The business organization of an air transport company is divided into two parts. First, that which has to do with the functioning of the line incident to carrying the cargoes with which the company is entrusted. Another part of the business organization sells the service and seeks to familiarize the public with the service offered. This organization, variously termed the traffic, commercial, or public relations department, functions much the same as the sales organization of any other company.

Because the activities of an airline are stretched over a considerable distance, the commercial organization is compelled to have a number of district offices. One is to be found in each of the most important cities through which the line operates. From these offices under the direction of a district manager, all matters pertaining to advertising, publicity, business solicitation, and public information are handled.

Because air transport is so new, and because the public has not yet become accustomed to thinking of air travel in the same way that it thinks of surface travel, the business organization of an air transport line must carry on a continual effort to familiarize the public with the capabilities and possibilities of using aircraft in their business and social life.

SURPRISING as it may seem, although over 40,000 miles are flown every 24 hours by the airmail in the United States, and perhaps half of that distance flown over passenger routes, many individuals still are not aware of the advantage which this new means of transportation offers to them personally in facilitation of their business. A rather humorous incident illustrative of this comes to mind.

Not long ago a gentleman leaving Chicago for New York on one of the popular extra-fare trains discovered after hurrying onto the train that he had forgotten his false teeth. He had left them in his hotel room in Chicago. He mentioned this to the dining car steward at lunch time and the steward suggested that perhaps he might care to make use of the airmail. At the next railroad station a telegram was dispatched to the hotel in Chicago asking that the missing false teeth be airmailed to a certain New York hotel. The next morning the gentleman was happy to find his false teeth awaiting him at the hotel upon his arrival in New York.

Whether or not air transport "pays" is a difficult question to answer. Many people who should know believe that the operation of an air transport line is already a profitable business. Others hold that it is still too new for them to judge whether or not that which appears to be profit at the moment may actually and safely be so termed. This is because no two airlines now in existence operate under identical conditions. Loads carried have not become stable enough to determine what the ultimate may be.

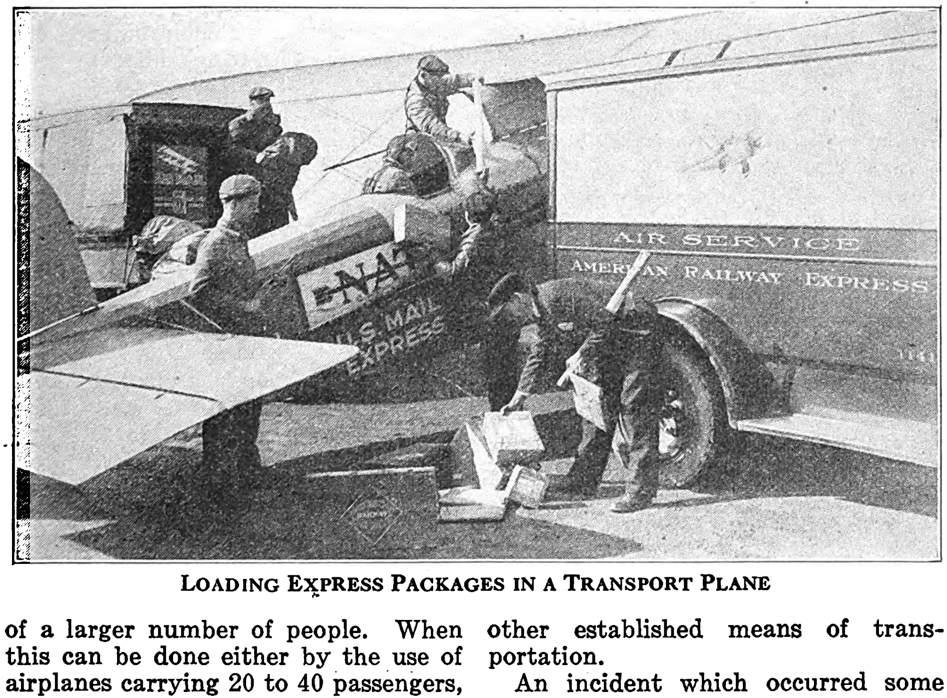
In general most of the airlines operating under government contracts carrying mail in the United States are showing a profit. Except in perhaps a few isolated cases, the same is not true of scheduled lines carrying only passengers. This is mainly because airplanes as yet available for these operators do not carry enough passengers to make the unit cost per passenger mile sufficiently low to show a profit with the number of passengers that are attracted to the service. This in turn is the result perhaps of two factors. One is that not a sufficient number of people have as yet become familiar with the advantages of air travel and another that for a large number the prices which must be charged under present circumstances are too high to be attractive.

With this in mind, it appears that the developments which will make air travel in the United States more popular are such improvements as will bring the cost of air travel within the reach of a larger number of people. When this can be done either by the use of airplanes carrying 20 to 40 passengers, or when smaller airplanes can be operated at a considerably less cost than at present, it is believed that airlines carrying passengers will prosper. Fear of the air no longer prevents people from riding, if a reasonable price can be charged for the service.

Undoubtedly the matter of fatalities as the result of air operations in the past have had a great effect on the public. Actual statistics indicate that scheduled airline operations are surprisingly free from occurrences resulting in fatal accidents and that most of the airplane accidents which occupy so much space in the pages of the public press are the result of irregular flying such as training, stunts of one kind or another, or some other hazardous type of flying that would never be experienced by a passenger on any regular air line.

Statistics from our own service in this respect may be of interest. Since the beginning of operations we have flown more than 5,000,000 miles. In all of this flying, five lives have been lost. These were pilots whose lives were lost in the service of the airmail as the direct result of weather conditions beyond human control and at a time when no passenger would have been in the air.

Likewise, ships are lost at sea in those rare instances when nature takes a hand in things and causes such weather conditions as are beyond the power of any man-made craft to endure. No doubt in whatever way we learn to travel in the future, this will still be true as it has been in the past. From the standpoint of comparisons it is felt that even with the meager progress which we have made to date, airplanes flying in scheduled service, licensed by the government, and operated by licensed personnel, afford no greater danger to the casual passenger than other established means of transportation.



LOADING EXPRESS PACKAGES IN A TRANSPORT PLANE

An incident which occurred some months ago revealed an interesting cause for a delay in transporting the airmail. Incidentally, it gives a good indication of the thoroughness with which the cause of each deviation from the schedule is investigated by those in charge of flying operations.

The westbound night mail from New York was late reaching Cleveland—later than warranted by prevailing weather conditions. When the pilot landed he was asked for an explanation. Shouldering the blame for the delay, the pilot explained that he had been forced to choose between maintaining his schedule and possibly saving several lives. In a village somewhere between Bellefonte and Cleveland he had noticed a house on fire. He could see that no one had given an alarm. Apparently the occupants of the house were asleep, totally unaware of their grave danger.

With his motor roaring, he zoomed over the house, returning again and again in an effort to awaken the occupants. Within a few minutes the people were aroused by the noise. They rushed out of the burning house in their night clothes, sounding an alarm in time to keep the fire from spreading and causing more serious damage. Some time later, with appropriate ceremony, the airmail pilot was made an honorary member of the village fire department.

As time goes on and the business increases, the organization of the lines will change to meet the situation. As it stands today, the United States mail forms the largest portion of the cargo. Express operated in conjunction with the Railway Express Agency forms another portion of the cargo. Likewise, on certain lines, passengers are carried with the mail. Undoubtedly the division of cargo will change as time goes on, as will the capabilities and limitations of aircraft and communication systems. With these changes will come changes in organization and with the expansion of the lines to cover the country and serve its cities more completely, so will the organization expand and become more adapted to conditions as they appear.

When it comes to considering air transport as a career, the answer would seem too obvious for comment. Here we have not only the newest but the greatest phase of transport development in the history of the world, in its infancy. It is no more possible to predict at this time what changes in our every-day life the use of aircraft will bring about than it would have been possible 20 years ago to have predicted with any degree of accuracy what changes in our life or what opportunities were about to be made possible by the increasingly wide-spread use of the automobile.

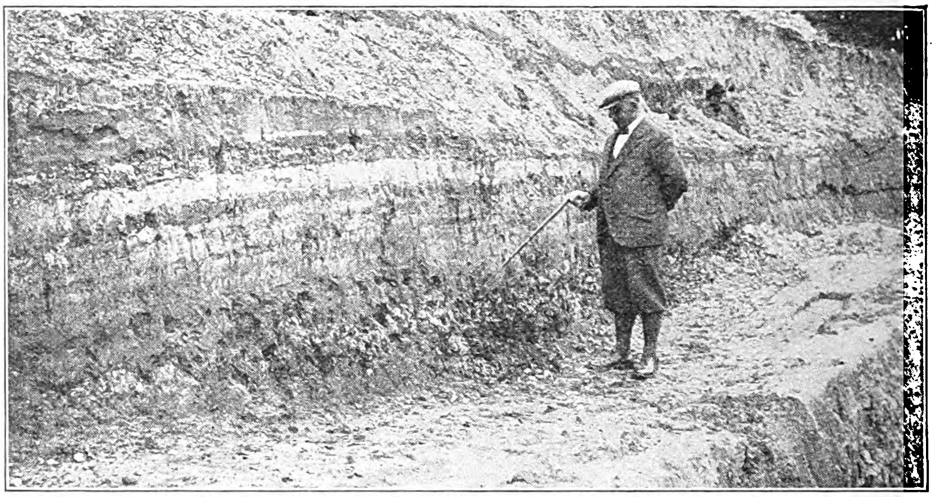
If one stops to consider, the automobile has not only affected the lives of each one of us but it is surprising how many of us are living in a manner that could not have been true were it not for the automobile. This is true even in addition to the hundreds of thousands of people who are actually employed either in the manufacture or operation of the automotive vehicle. The same will be true, except in a much greater measure, as the result of the airplane.

The Art of Pliocene Man

More Discoveries Made in Eastern England Strengthen the Belief That Very Ancient Man Was Highly Intelligent

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland



THE AUTHOR POINTING TO THE BONE BED

Above this bed are: Loamy Red Crag sand, 48 inches; glacial gravel containing many flints, 58 inches; upper chalky boulder clay laid down by an ice sheet, 36 inches; surface soil

WHEN, in 1909, I discovered the flint implements of Pliocene man beneath the Red Crag of Suffolk, England, it was at once apparent that these artifacts were by no means as primitive in their forms and flaking as their great age would have led us to expect. In fact, a study of these specimens soon satisfied me that their shaping had been carried out by people having a considerable knowledge of the fracture of flint, and that it was not possible to believe such implements were made by some semi-human, ape-like creature.

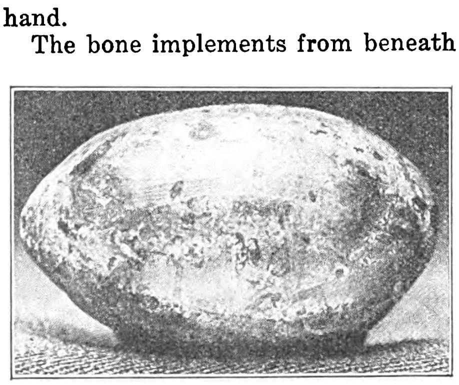
The complex and clever manner in which the "rostro-carinate," or eagle's beak, specimens had been produced showed that thinking brains were operating in Suffolk some 500,000 years ago, and this conclusion was supported by an examination of the other sub-Red Crag implements such as side scrapers, push-planes, borers, and choppers.

The Pliocene implements of East Anglia are made in the great majority of cases by the removal of large flake scars, and anyone who has flaked flint and attempted to shape it to any desired form will have realized the extreme difficulty of doing so by means of such bold flaking. It is, in fact, easier to make an implement by the removal of small flakes, such as were detached in late and Stone Age times.

THUS the extensive amount of material which I recovered from the Bone Bed beneath the Red Crag convinced me that on the ancient land surface of Pliocene times in East Anglia there lived a race of hunters who were adepts in flint flaking, and who had progressed some distance upon the path of human evolution. In order to demonstrate the truth of this statement I have drawn a sketch of a beautifully-made scraper in flint from beneath the Red Crag at Bramford in East Suffolk. It is made from a flake, and will compare favorably with many of the scrapers produced at much later periods.

Having thus realized the state of advancement of Pliocene man, it was not, therefore, a great surprise to me to find associated with his flint implements certain specimens of shaped bone. The Bone Bed beneath the Red Crag is, as its name implies, rich in ossiferous remains, chiefly in a fragmentary state. These bones are of widely different ages, some dating back to the Eocene Epoch, while others are to be referred to the end of Pliocene times when the Crag Sea was invading the slowly sinking coast of East Anglia. It is evident that the people of those days had realized the many uses to which bone could be put if suitably shaped, and I illustrate two specimens from beneath the Red Crag. The drawing in the right-hand column of the opposite page shows views of a pointed bone made from a large piece of rib. It is most definitely artificial and would have served admirably for making holes in skins and for other similar purposes. The specimen illustrated in the center of the opposite page is even more remarkable. It is also made from a large piece of bone and at one end has been rubbed into a well marked hollow. In dressing skins such a tool would be of great value, as the pelt could be placed over a rounded stick and "dressed" by means of the hollowed bone held in the hand.

The bone implements from beneath the Crag are of great variety. They are very highly fossilised and when struck with another hard object ring as does metal. Often, as in the case of the specimen just referred to, they have been perforated by the boring mollusca of the Crag Sea which inundated the land surface upon which Pliocene man had lived.



THE REMARKABLE FIND

The sling stone described in the text. Marks due to shaping show clearly

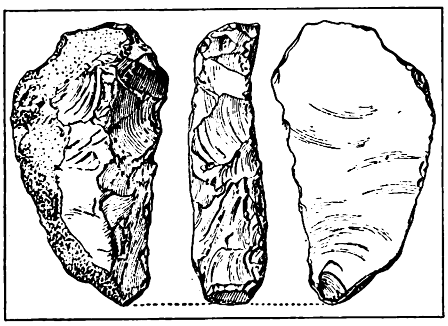
Although these discoveries in such an ancient deposit of well-made implements and bones were sufficiently surprising, they pale into insignificance when compared with another specimen, the discovery and details of which I will now describe.

DURING the year 1926 I conducted excavations in the Bone Bed beneath the Red Crag at a pit designated as Pit No. 1 on the north bank of the River Gipping at Bramford, near Ipswich. The photograph at the top of the page shows the section of the pit, the Bone Bed lying at the base, upon the harder clay upon which I am standing. In their work at this quarry its owners remove and dump the surface soil, the boulder clay, and the glacial gravel, while the loamy sand, representing the Red Crag, is utilized in making bricks. When we started excavating in 1926 we found an area of considerable extent of this loamy sand left in place upon the underlying Bone Bed, and before beginning to search for any specimens in this latter deposit the loamy sand was barrowed away. Thus it is clear that any object found in the compact Bone Bed must be referred to that deposit and could not have been derived from any higher and later accumulation. The Bone Bed at Pit Number 2, Bramford, rests at an elevation of about 100 feet and occupies its normal position in the area under dicussion upon the surface of the harder clay. Further, its contents, as examined by me, accord with those of the other exposures of the same deposit in various parts of Suffolk, and are made up of typical Bone Bed material. Moreover, the beds surmounting the loamy sand at Pit Number 2, Bramford, do not exhibit signs of glacial disturbance such as might have ploughed into the Bone Bed and rearranged it with later material.

The conclusion therefore must be that the remarkable object now to be described which was removed from the Bone Bed by my trained excavator, John Baxter, formed an integral part of that deposit.

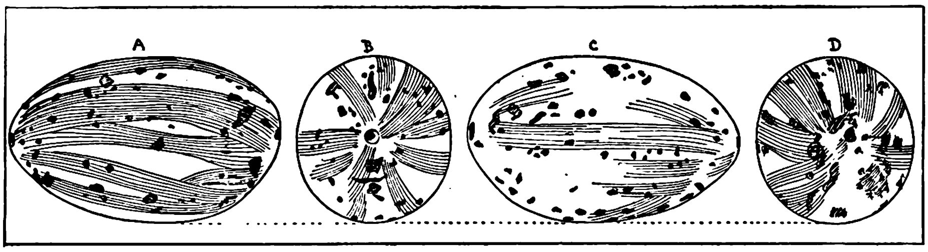
WHEN the diggings carried out in 1926 were in progress, the various specimens deemed worthy of preservation were brought to my house, labeled, and put away in drawers. Among these items was an egg-shaped object which my excavator brought home because of its somewhat unusual form. This specimen, I regret to say, I did not submit to any close examination, and its real and remarkable nature remained unrecognized until the occasion of a visit to my house of the distinguished archeologist, Professor H. Breuil. Prof. Breuil was greatly impressed with the object and, at my request, wrote the following account of it for insertion in the records:

"While I was staying in Ipswich with my friend J. Reid Moir, we were examining together a drawer of objects from the base of the Red Crag at Bramford, when Mr. Moir showed me a singular egg-shaped object which had been picked up on account of its unusual shape. Even at first sight it appeared to me to present artificial striations and facets, and I therefore examined it more closely with a mineralogist's lens. This examination showed me that my first impression was fully justified and that the object had been shaped by the hand of man. In shape it is like a rather elongated egg, with one end slightly blunter than the other. At each end there is a small depression or punctuation, and other punctuations are visible on the body of the object, four or five being grouped together in places into a rhomboid, or a straight line. It is possible that these are merely due to the decomposition of crystalline grains included in the general mass (which appears to me to resemble steatite). These tiny depressions are still filled with grains of sand cemented with ochrous and manganese material, spots of which have stained the object at various points on its exterior.



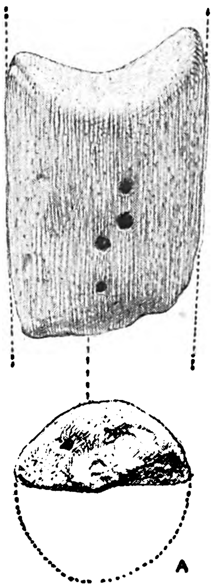
PLIOCENE FLINT SCRAPER

"There lived a race of hunters who were adepts at flint flaking. . . ." See the text



FOUR ASPECTS OF THE MANUFACTURED SLING STONE

Drawn by the author. Natural size. The Pliocene Epoch preceded the Pleistocene, or glacial Epoch, but the author and some others place the first glaciation in the Pliocene Epoch



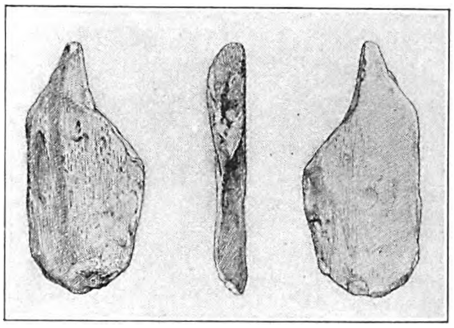
SKIN DRESSING TOOL

This also was found in the Bone Bed. It was doubtless used for dressing skins

"The whole surface of the 'egg' has been scraped with a flint, in such a way that it is covered with a series of facets running fairly regularly from end to end. Each one of these facets is made up of a number of longitudinal striations, the fine parallel lines being of unequal depth, as though they had been made by a slightly broken edge of flint. A number of fine concentric incisions are visible at one of the poles; and others more or less oblique, one of the latter being fairly deep. The scraping described above covers the whole surface of the object and penetrates into its irregularities. As it stands, the object is entirely artificial, and although somewhat smaller it recalls the steatite sling-stones of New Caledonia."

With this excellent report I am in agreement. The specimen has now been submitted to various well-known archeologists who have without exception agreed that it is artificially shaped, and conforms in its general appearance with the sling-stones mentioned by Prof. Breuil. The object, which is of a greyish-brown color, weighs, approximately, one half ounce. It measures in greatest length 1⅜ inch, and in greatest width ⅞ inch. The material of which it is composed seems now very hard and its exact nature, at present, remains in doubt. I imagine that, at one time, the specimen must have been in a somewhat softer condition to allow of the shaping being carried out as, in its present state, such shaping would, I believe, be impossible. In experiments I conducted in shaping clay with a sharp piece of flint I found that I produced markings in every way comparable with those observable upon the "sling-stone."

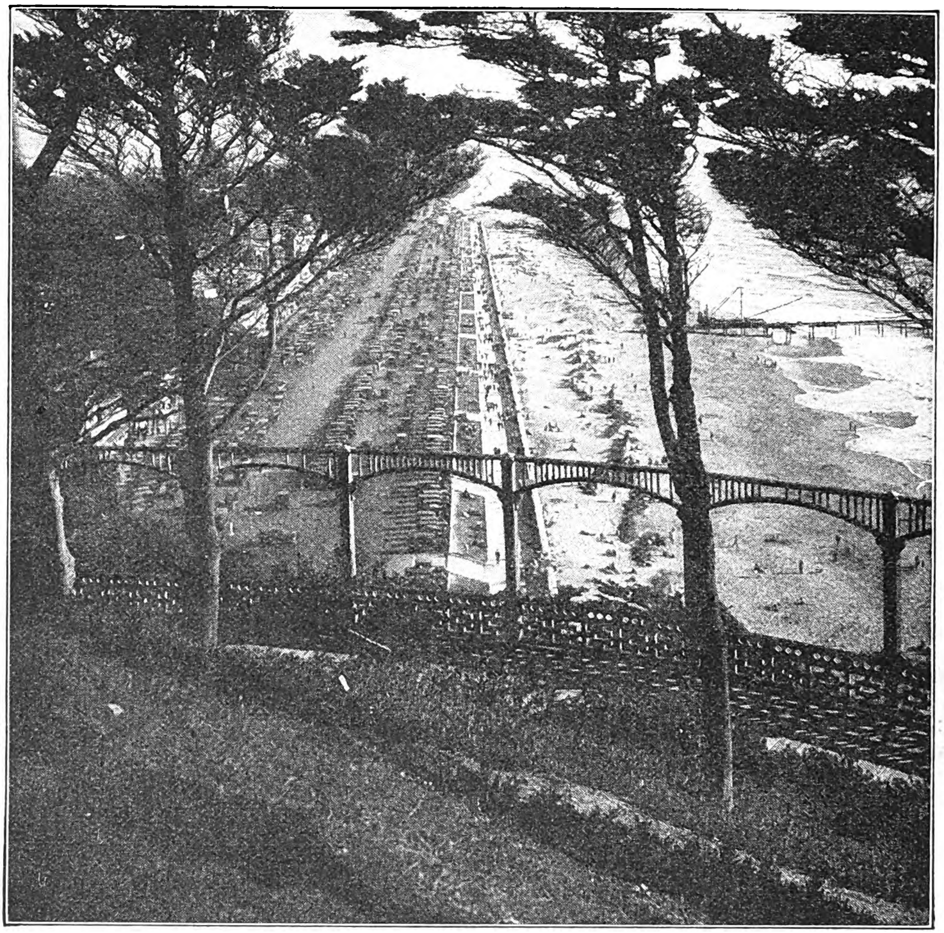
The specimen is illustrated by a photograph and by drawings which are reproduced above. The photograph appears on the opposite page.



ANOTHER FIND

A piercing tool made from bone. These drawings are three eights natural size

There would seem to be no need to stress the importance of the discovery of this "sling-stone" in a Pliocene deposit. It has suddenly illuminated, as it were, the human Pliocene stage, and shows us a picture of man's advancement hitherto regarded as impossible at that remote epoch. This "sling-stone" is more than an ordinary artifact—it is a work of art—and its significance upon our whole outlook on the antiquity of the human race must be profound.



Courtesy Californians, Inc.

PART OF THE BOULEVARD FROM SUTRO HEIGHTS

An old section of the esplanade that is built along the sea beach of Golden Gate Park. The new and broader extension runs off in the distance. It is a popular recreation point

Esthetic Engineering

How San Francisco Anchored Shifting Sands and Built a Beautiful Boulevard on What Had Been a Barren Waste

By C. W. GEIGER and RUTH SABICHI

MANY of San Francisco's civic achievements have excited universal admiration. And no wonder! A smouldering mass of ruins after the earthquake and fire not quite a quarter of a century ago, this Pacific Coast city has had the advantage of being able to start anew, practically to build according to modern ideas from the ground up and to take advantage in its city planning of experience gained from the former mistakes which the disaster had blotted out. The spirit of modernity therefore prevails in a great many of the city's buildings and public works.

The foresight of the city planners is reflected in a thoroughfare which is now nearing completion under the direction of the San Francisco Park Commission with Superintendent John McLaren in charge. In fact, this new boulevard, which is called the Great Highway, is said to rank second to no other of this city's proud possessions. It is 400 feet wide and extends from the world famous Cliff House in the city, three miles southward to Sloat Boulevard. Extension of the solid concrete esplanade from Fulton Street to Lincoln Way is a part of the work. This covers the entire frontage of Golden Gate Park and its completion will mark the culmination of years of planning.

THERE are three primary phases of this great work: the construction of the concrete esplanade, the use of sea bent grass for building up the area on which the highway is constructed, and the building of the highway itself.

At the section near Lincoln Way, where the work under the careful supervision of John McLaren is being done, a great problem was presented to the engineers. This was the conquering of the drifting sand which previously was piled up or blown away by wind and waves. "Sea bent was the answer to this problem," said Mr. McLaren. "This deep-rooted grass, an immigrant from France, has done more to add to the area of San Francisco than any other agency of which I am aware. Sea bent, of which we planted the first seed many years ago, has reclaimed probably 150 acres along the beach from Lincoln Way south to the city limits. It has such a peculiar adaptability that it thrives best in sand where the wind is strong. The deep roots and tall leaves hold the sand so that drifting is prevented and the sand is made to pile up. By preventing the sand from blowing inland the beach has gradually been extended seaward." It is upon this reclaimed sand that the boulevard is being constructed.

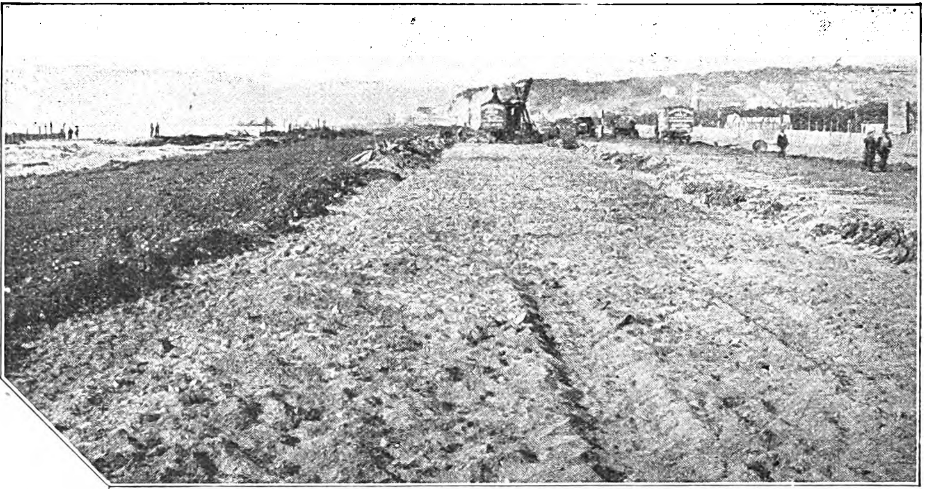
It is doubtful if there is anywhere in

the world a thoroughfare as wide and as beautifully built as the Great Highway. The various drives and walks on this thoroughfare are laid out as follows, from east to west: First, there is a 15-foot walk, then a 40-foot service road which is used for general traffic in both directions. To the west of this is a 60-foot section of lawn and shrubs sloping up to a level about 8 feet higher than the lower road. Then comes a 20-foot bridle path, and west of this a lawn 10 feet wide. West of this lawn there is a 50-foot concrete road for one-way traffic. Then there is another stretch of grass and shrubs and another 50-foot concrete roadway for one-way traffic. Between the western side of the last mentioned roadway and the ocean beach is another lawn set with trees and shrubs, and also a wide foot-path. From this foot-path, the slope down to the beach sands is heavily planted with sea bent and trees, generally cypress, to prevent drifting.

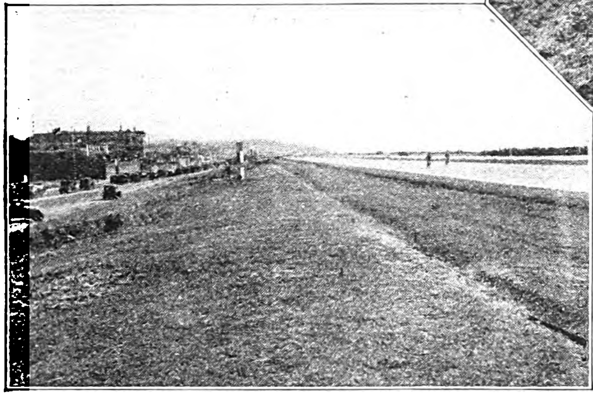
An underpass which will permit pedestrians to walk from the Ocean Beach Chalet to the beach without encountering traffic, and an adjacent equestrian ramp are among the engineering features of the project that have attracted widespread interest. It is believed that the equestrian ramp is a new departure in highway construction. It will enable horsemen to ride down the face of the esplanade to the ocean and will serve further as a protection against high tides during storm periods. The ramp is built directly on the face of the esplanade and is reached from the main highway.

The first sections of the esplanade were built many years ago, and, successfully withstanding many winters of pounding by the Pacific Ocean, have demonstrated that this is a satisfactory method of protecting the world-famous beach. The esplanade is constantly being extended as money is provided; the last extension, just completed, provides a solid concrete esplanade from a short distance south of the Cliff House to Lincoln Way.

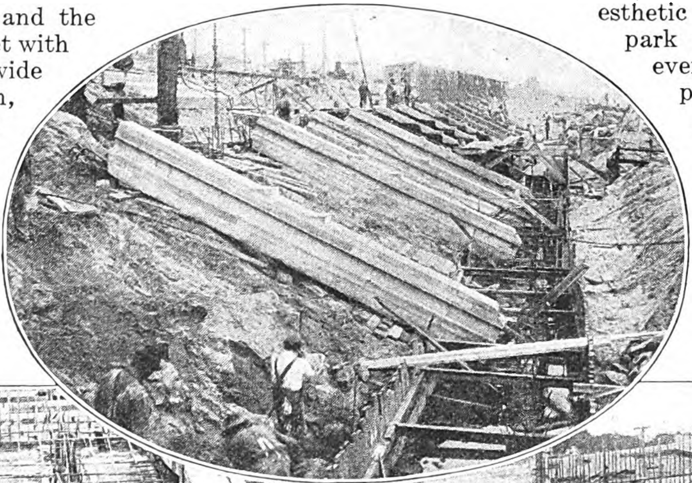
THE popularity of this great engineering project which lends an esthetic note to an already beautiful park is attested by the fact that every day hundreds of motorists park their cars back of the esplanade (and on Sundays and holidays this number of motorists is increased to thousands) where they may view the mighty Pacific in absolute safety. Here they may rest and watch the waves pile up the sand against the steps of the es-


PREPARING THE BOULEVARD GRADE

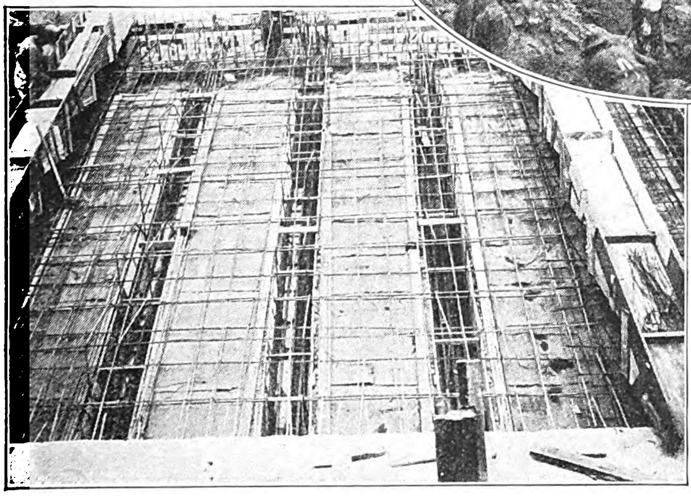
The boulevard was built upon sand drifts—land that had been reclaimed by planting sea bent grass. This illustration shows the work of grading


A STRETCH OF LAWN

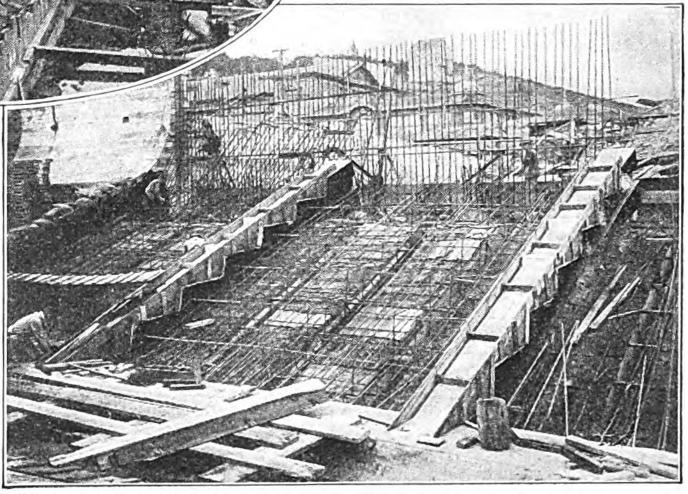
At the left is the eastern footpath and roadway, in front is a lawn section, and at the right are the main roadways


THE "H" BEAMS ➤

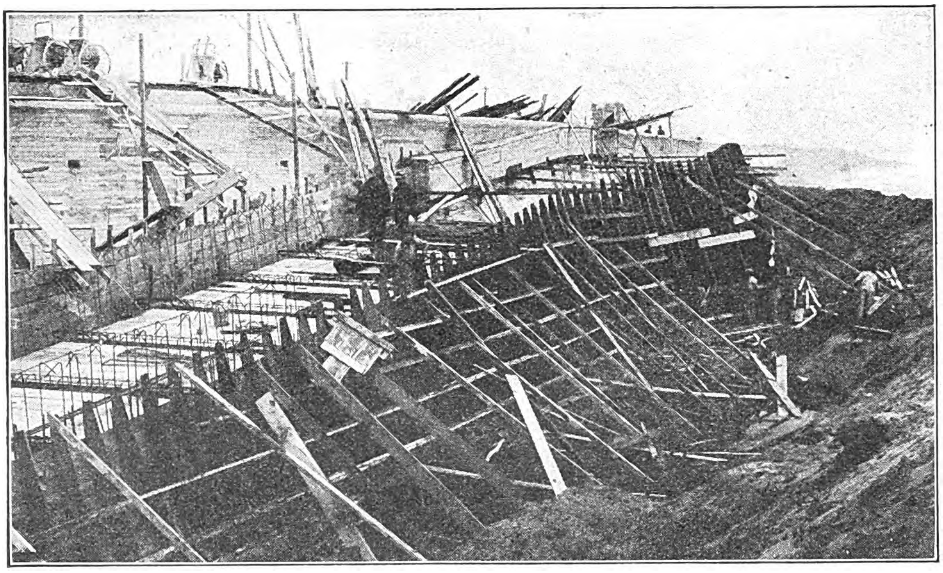
Beams to provide slip joints, in place. In the trench at their lower ends are the piles


READY TO POUR CONCRETE

Forms, reinforcing steel, and the "H" beams with tar in their side grooves—all ready for the concrete. Note the complex reinforcing


THE FINISHING TOUCHES

Concrete has been poured around the projecting tops of the piles and men are making the final connections of reinforcing steel



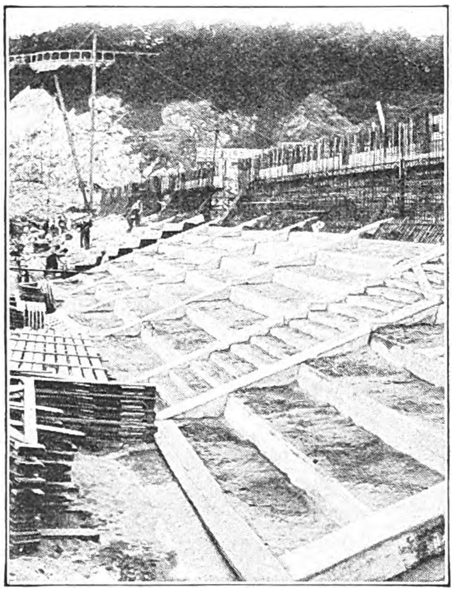
FOR THE EQUESTRIAN RAMP

Workmen placing the forms in which is to be poured the concrete for the equestrian ramp. This ramp permits horses to be ridden down from the boulevard above to the beach sands

planade in the winter time so that the water line is far out from the base, or see it removed during the summer months so that the waves break almost directly upon the steps below them.

The esplanade has a front wall which was formed by driving interlocking concrete piling to a depth of 13 feet below extreme low tide. "Bleachers," or steps, have been built in the lower section. The top bleacher riser develops into a rollway and this rollway ends at the top of, and forms part of, a three and one half foot parapet wall with returns at each side of each stairway section. Beyond this parapet is a 20-foot concrete sidewalk with weep holes to release wave water. Behind this esplanade is the Great Highway extending from the Cliff House to Sloat Boulevard along the Pacific Coast for about three miles.

THE method of constructing this mighty esplanade which has successfully withstood the pounding of the ocean embodies several unique features. The concrete piling was placed by four water jets, one jet being held at each corner of each pile as it was driven. The piles that form the front row—that nearest the ocean—were interlocked by means of steel construction. After the piles were driven, the sand between their upper ends was washed out and the space around the projecting piles filled with concrete, making practically a solid concrete wall. The steel interlocking makes it impossible for the piles to pull away from each other, either vertically or horizontally.



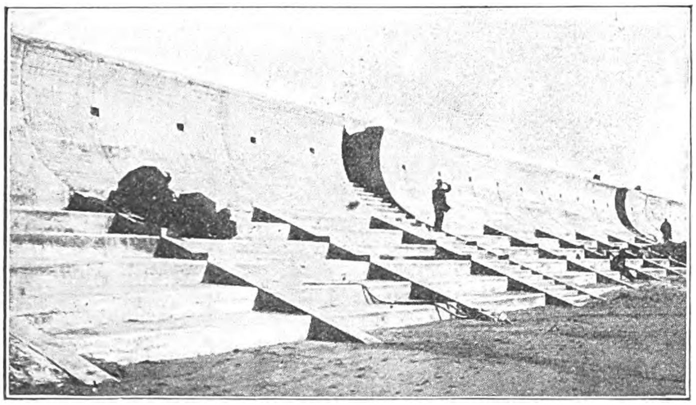
PARTLY COMPLETED

The bleachers completed, the wall yet to be built—looking toward Sutro Heights

This steel interlocking works something like the tongue and grooving in flooring. In setting the piles, they were picked up by a crane and raised so that the interlocking steel in the bottom of each suspended pile fitted into the interlocking steel at the top of the last pile driven. It was then lowered so that the bottom of the pile rested on the sand. The jets were then started and, as the sand was washed from under the bottom of the pile, its weight caused it to sink into its final position.

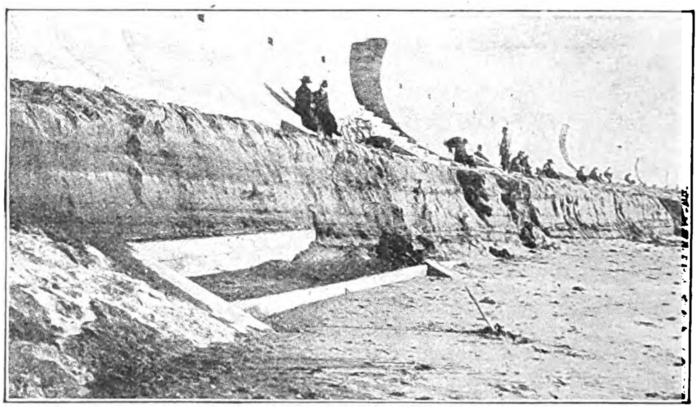
THE work is provided with expansion joints in the form of heavy concrete "H" beams so that there is no danger of cracking. On each side of the "H" beams there is a groove running the entire length of the beam. Hot tar is poured into these grooves and the concrete which forms the bleachers is then poured. Running into the grooves, the fresh concrete, because of the tar, does not stick to the "H" beams, thus giving a slip joint which allows the concrete to expand and contract, after setting, without cracking any of the other work. The grooves also extend to the top of the back wall, thus binding the entire structure rigidly together, yet at the same time permitting the sections to give when struck by a high wave, due to their lack of rigidity or, we might say, due to their flexibility.

The lower ends of the "H" beams rest on the interlocked sheet piling. A concrete slab four feet thick and six feet wide binds the lower end of the "H" beams to the top of the interlocking piles. At the upper end of beams bearing on pedestal piles is a similar cap which ties the upper portion of the beams to the pedestal piles. There is also a groove, similar to those in the "H" beams, which provides expansion joints for the rollway.



IN SUMMER TIME

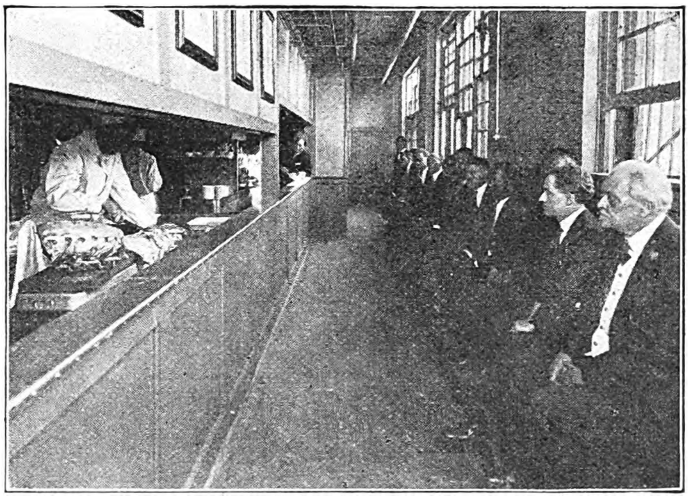
During the summer the bleachers, or risers, are washed free of sand by the action of the waves and furnish convenient seats



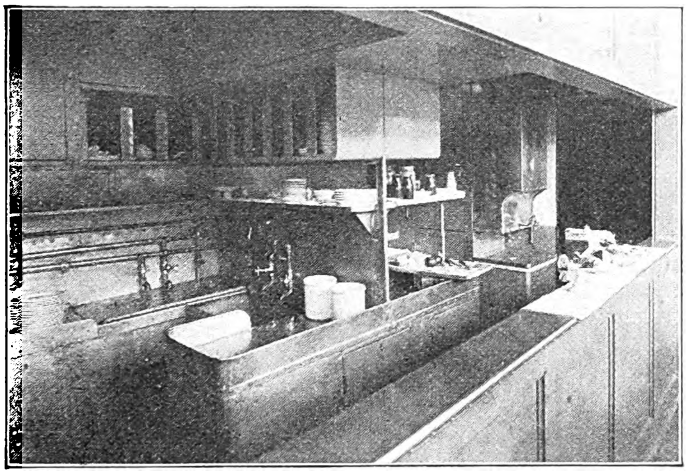
AND IN WINTER

Winter storms pile up sand against the bleachers as shown in this photograph but this is gradually washed away by the waves

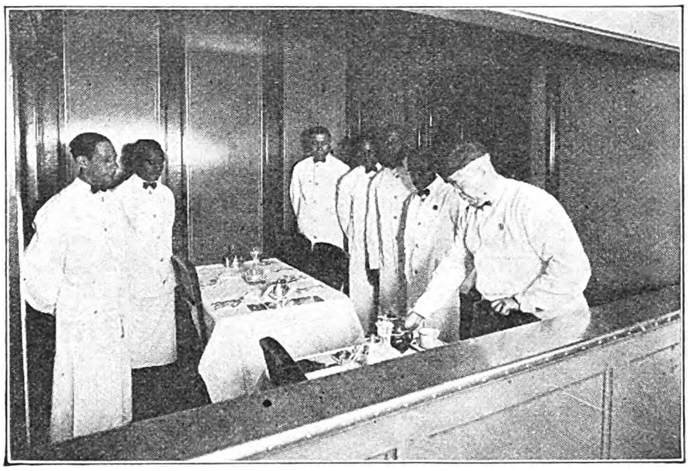
CANTALOUPE BALL SALAD
When these men get back on their cars one more dessert will be added to their repertoire. The kitchen simulates the real thing



STEWARDS AND CHEFS FRONT
The instructing chef is demonstrating to a group of stewards and chefs the proper method of preparing the meat for roasting



AN IMMOVABLE DINING-CAR KITCHEN
One end of the pantry and kitchen of the training school. The arrangements are exact duplicates of those on railroad trains

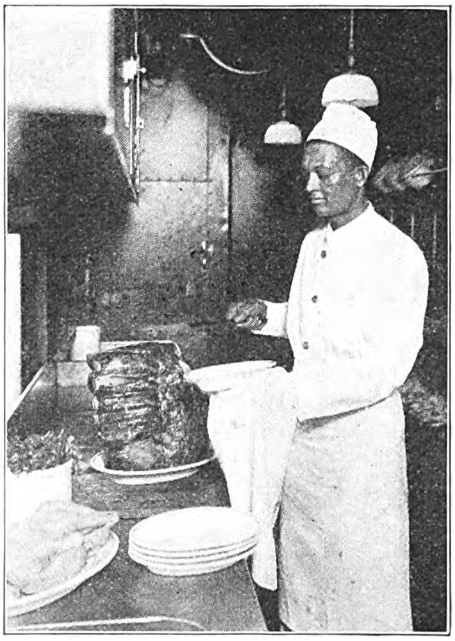


A LESSON IN MANNERS
This is a view of the dummy dining compartment in the Pennsylvania's training school and kitchen for dining-car employes

When the Dining-Car Staff Goes to School

YOU have perhaps often wondered at the deft service and tasteful viands which the dining car affords. These are the net result of very efficient training and the use of excellent materials. Then the question arises, "Do dining cars pay?" No, they do not. One large trunk line tells us that their dining cars "went into the red" for seven hundred and fifty thousand dollars in 1927. Another road advertises the fact that they lose 19 cents on every meal served on their dining cars. You might ask, "Why do they run them?" The answer is—competition. Passengers have to be fed one way or another, and the dining is quicker and more satisfactory than the old station restaurants where the whole trainload was disgorged for 20 minutes of indigestion.

The Pennsylvania Railroad maintains a school for dining-car employes at its commissary at Columbus, Ohio. Every dish on the menu is prepared from printed instructions, but the end is not there. Personal instruction is added in a school which is an exact reproduction, both in space and equipment, of the latest type Pennsylvania Railroad dining-car, built into and forming a part of the Columbus commissary. Every feature from kitchen utensils, range, boiler, and pantry, to the dining-room and tables for patrons, has been faithfully reproduced in the commissary. Even the connecting aisles and corridors have been retained. The men see everything done in an ideal way, by skilled instructors. Not only the chefs but the waiters receive from time to time lessons which bring them up-to-date after their initial instruction. All new employes undergo rigid training and instruction before actual service on the road. Under the present arrangement the men go to school for an hour's instruction before they leave for their road trips. The average employe spends approximately three hours a week at school. Tests are also made to develop improved methods in the preparation of dishes and their combinations to be served on the diners en route.



"ROAST BEEF RARE"
This teacher-chef knows how to cook roast beef and his pupils will be shown how to duplicate the culinary feat

THE WHOLE FAMILY FLIES

The Ford trimotor plane is in use on several airlines, and inspires passengers with its readily apparent staunchness

Stout
AIR LINES
DETROIT CLEVELAND
CHICAGO

American Passenger Air Transport—III

Many Facts of Great Interest to the Prospective Airline Passenger Are Here Discussed at Length

By PROFESSOR ALEXANDER KLEMIN
Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, SCIENTIFIC AMERICAN

(*Concluded from November*)

IN technical circles, there is still some argument as to the comparative merits of single-engined and multi-engined planes. The arguments in favor of the single-engined plane are somewhat as follows: That they give the pilot less to think of at one and the same time; that the pilot has fewer gages to look at and only one engine to listen to; that a single-engined plane is more efficient than a multi-engined plane; that, while undoubtedly a multi-engined plane is more reliable as regards power plant, there are other hazards such as stalling, pilot's mistakes, fog, and bad weather to contend with, and that a multiplicity of engines is no safeguard against such hazards.

The very definite replies to these arguments is that safety is paramount and that while a more reliable power plant does not of itself insure safety, it is a most important contributing factor; that the pilot of a multi-engined plane soon accommodates himself to his task; and that nothing contributes more to a feeling of security among passengers when flying over unfavorable terrain, than the sight of three powerful engines in lieu of one.

No less an authority than Colonel Lindbergh has definitely expressed himself in favor of three or even four engines. The general practice of our operators also indicates that the multi-engined idea will prevail. A survey of the various airlines gives the following data relative to the type of planes in use: Single-engined planes on 16 passenger lines; twin-engined amphibians on four lines (the Sikorsky amphibians are quite capable of flying on one engine out of the two); three-engined planes on 16 lines. There is little doubt that, as air traffic increases in volume, very few passenger lines will be equipped with anything but multi-engined machines.

IT is interesting to note General Atterbury's reasons for the selection of Ford trimotor planes for the T. A. T. "A number of tests were made by Colonel Lindbergh and his associates on the technical committee, of different passenger planes, at Los Angeles, Seattle, New York, and Detroit. These tests lasted well into the fall of 1928, as new models of passenger planes were being perfected. The type of ship finally selected for the initial order was a Ford trimotor, all-metal monoplane, capable of carrying ten passengers. The first consideration in making this selection was that of safety. Trimotored ships can fly on any two of their three motors; and, with only a single motor running, will lose altitude so slowly that they still have a wide landing radius—more than 50 miles, for example, from a 10,000-foot altitude." Granted that more than one engine should be used for passenger air transport, there is still the question as to whether two or three engines should be used. The answer is one of simple arithmetic: If the twin-engined plane can fly on one of its two engines, then it is much safer than the three-engined craft, because it has only two engines to give possibility of trouble instead of three.

When one engine in a twin-engined plane quits, the following difficulties arise:

The engine still functioning gives through its propeller a powerful eccentric thrust, which tends to turn the machine violently round. The pilot has to apply powerful rudder, and bank the machine somewhat. Both these actions increase the horsepower required to keep the plane flying. At the same time the propeller of the remaining engine is working under disadvantageous conditions, because it has to absorb the full power of the engine while the forward speed of the plane is slow.

A few years ago, plane designers thought it impossible to meet these conditions. Now by improvement in aerodynamic design, by careful study of propeller characteristics, and by the use of special rudders at least two twin-engined transports have definitely shown that they can fly on one engine alone. These are the Sikorsky amphibian and the Curtiss *Condor*.

If they give proof of this quality under continued service conditions, designers may rapidly swing to twin-engine design. Besides the possibility of greater power plant reliability, a twin-engined machine has a number of advantages. The propeller placed at the nose of a very large cabin fuselage is never highly efficient. In the twin-engined job, no such blanketing need be feared, since the engine nacelles can be nicely streamlined. The pilots can now be placed at the very front end of the fuselage where their vision is unimpeded. Engines, gasoline system, and piping can be removed from the fuselage, thus adding to the safety and comfort of the passengers. Since there is no engine in the nose, vibration is likely to be decreased in the cabin. These are all important considerations.

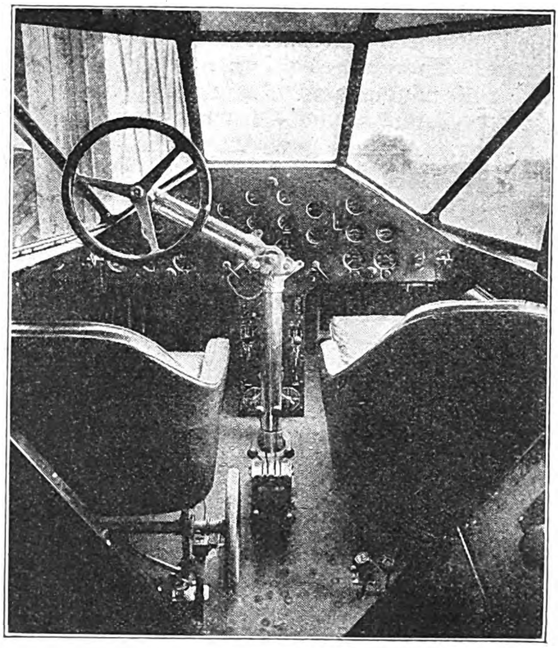
In view of the large number of plane types employed in passenger transport (descriptions of several of which have already appeared in the SCIENTIFIC AMERICAN) we shall be obliged to deal with them rather briefly. It may be of interest, however, to give greater detail on the very latest (at the time of writting) large passenger transport, the 18-passenger Curtis *Condor*, which presumably embodies much of the experience gained by operators to date. (See also article on page 488 of this issue. Editor.)

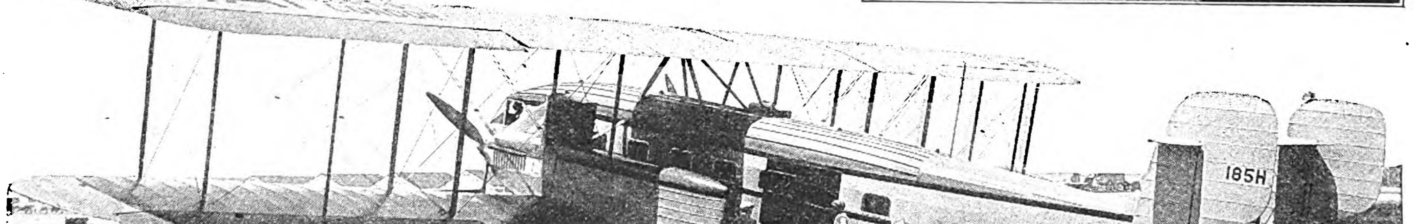
The first point of difference between the *Condor* and other large passenger airplanes, is that the Curtiss is powered with two instead of three engines. The *Condor* has climbed to and maintained an altitude of more than 5000 feet when fully loaded. If similar performance is maintained under service conditions, a real element of safety will have been added. Engine maintenance costs, an important point in airplane operation, are also likely to be less than with three engines.

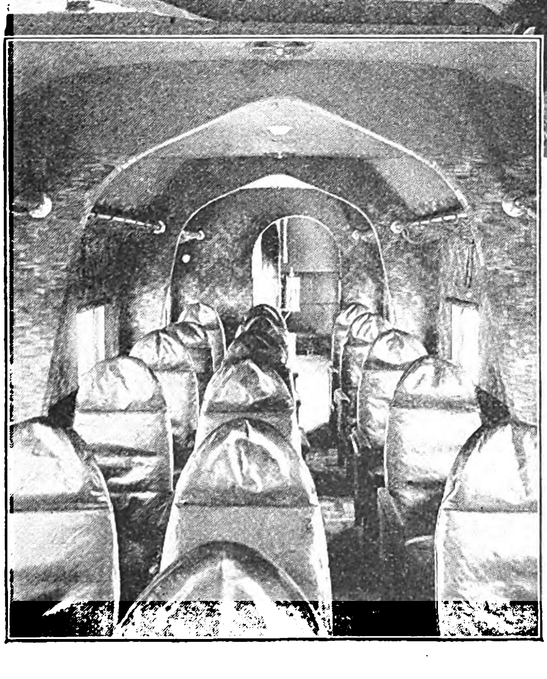
Furthermore, the engines are water-cooled instead of being air-cooled. The arguments advanced are that water-cooled engines are less noisy than air-cooled types with their exposed valve gear, that with varying weather conditions, temperature regulation in the water-cooled type is finer, and that with proper care, the water-cooled type is actually more reliable. These are plausible arguments, although the "come-back" of the water-cooled type is by no means a certainty.

The general characteristics of the *Condor* are: Engines—two Curtiss Conquerors (geared down) with a total horsepower of 1200 at 2400 revolutions per minute; weight empty—11,352 pounds; useful load — 6026 pounds; crew — 510 pounds; fuel and oil — 1916 pounds; pay load — 3060 pounds for passengers, 540 pounds for baggage; gross weight—17,378 pounds; length overall — 57 feet 1 inch; span overall—91 feet 8 inches; wing area—1512 square feet; wing loading in pounds per square foot—11.50; power loading in pounds per horsepower—14.47. The performance is as follows: high speed—139 miles per hour; landing speed—49 miles per hour; cruising speed—116 miles per hour; absolute ceiling—19,200 feet; and maximum range at cruising speed of 116 miles per hour—five hours.

The framework is entirely of metal, mostly duralumin. The biplane form of wing cellule was selected to keep the span to reasonable dimensions and provide a light structure. The engines are geared down 2 to 1, so that the 13-foot propellers may work in correct relationship to the speed of the plane. Wheel brakes are standard equipment, as are gasoline dump valves, running lights, and signal flares.



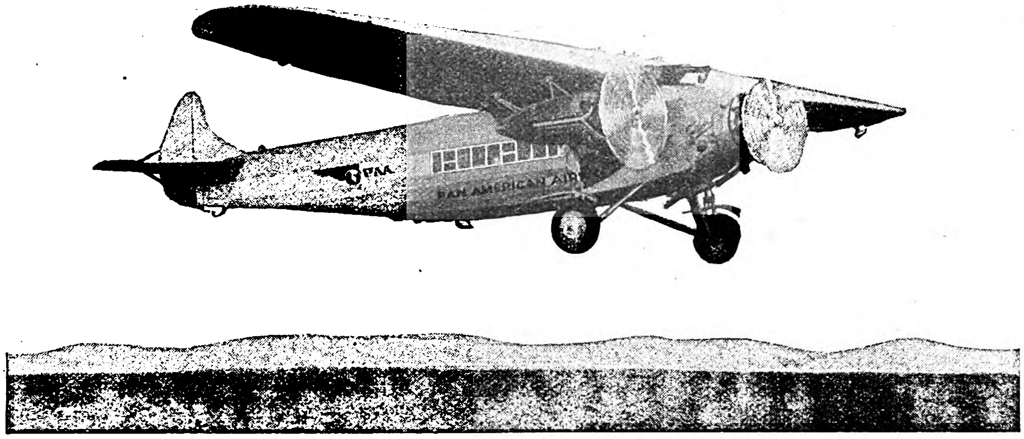




THE TWO-MOTORED "CONDOR"

Above: A three quarter rear view of this 18-passenger plane. *Above at right:* The interior of the pilots' compartment showing the dual controls and the complete instrument board. *Left:* Looking toward the rear of the passenger compartment

Radio communication with the ground is essential at all times. The radio equipment, installed by the Radio Corporation of America, consists of a 100-watt combination telephone and telegraph transmitter operating on 600- to 950-meter wavelengths. Its source of power is a dynamotor which draws its current from the standard landing-light batteries of the plane. The receiving equipment is designed for frequencies used by the marine stations of the United States Coast Guard and



THE FOKKER TRANSPORT PLANE "CHRISTOPHER COLUMBUS"

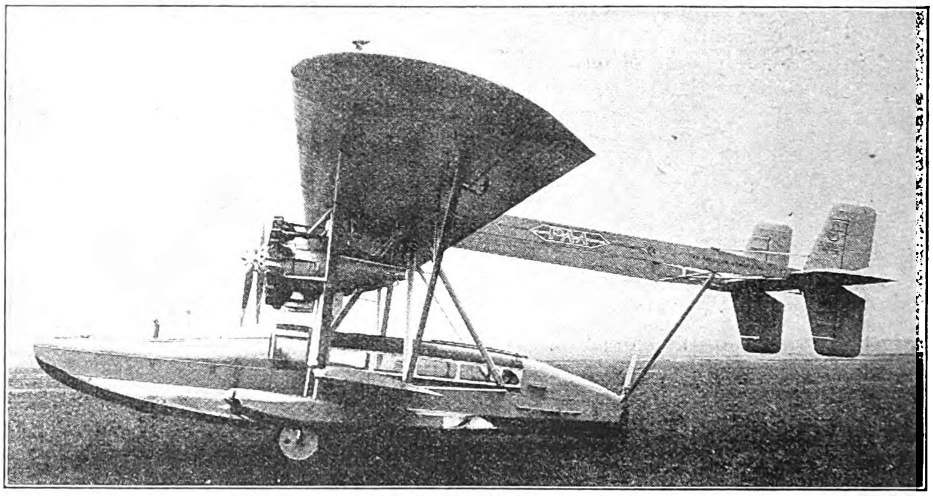
the stations of the Airways Division of the United States Department of Commerce. The entire equipment weighs but 145 pounds and was developed by the Radiomarine Corporation of America. A trailing wire antenna is used.

The chairs in the *Condor* are comfortable and luxurious, although they can be lifted by a small child. They have high backs tapering to padded headrests, and are covered with durable top-grain leather. These "super-chairs" are adjustable automatically to any angle of inclination. The passenger accomplishes this adjustment by leaning back to a satisfactory position; the chairs will retain the exact angle.

Draughts or excessive cold will not be tolerated by the traveling public, yet fresh air is demanded. The *Condor* cabin has 48 cubic feet of air per person, since there are 18 passengers, a floor area of 138 square feet, and a cabin height of 6 feet 3 inches. Also there are ventilators for admitting air through the roof of the plane, and capable of being carefully regulated. One is located in the pilot's compartment, one in the main cabin, and one in the lavatory.

To avoid the discomforts of leakage in an exhaust gas heater, steam heat is employed. Two small radiators weighing less than a pound and containing superheated steam are located below openings in the floor. The steam is obtained from two tiny boilers located in the exhaust manifolds of the engines.

The interior of the cabin is divided into three compartments, separated from each other by arches. Each compartment accommodates six passengers, and if desired the operator can shut off each compartment from the other by means of doors, thus giving the equivalent of a railway drawing room. The compartments have attractive carpets and the interiors are finished in light-weight paneling upon which the grain of natural wood has been reproduced. Over each seat is a rack on which light articles may be placed.



THE SIKORSKY S-38 AMPHIBIAN

There is a window beside each set of seats. The windows are fewer in number and smaller than one would expect, but the vision is adequate. The reason for smaller window space is probably that glass is a poor insulator of sound and heat. For sound-proofing and vibration-damping purposes an air space of approximately three inches exists between the inner and outer walls of the cabin, packed with a sound and shock-absorbing material. (See second part of this article in our November issue. Editor.)

Provision is included for the installation in the main cabin of a private compartment with four sleeping berths each 28 inches wide. For night flying the *Condor* cabin can be converted into a sleeper with 12 full size berths. Space can also be arranged for the installation of a desk set, buffet, and a refrigerating system at the order of the operating company.

All baggage is carried in two metal-lined compartments, one in each outboard engine nacelle aft of the gas tanks. This is a new wrinkle in airplane design, as it leaves all available cabin space at the disposal of the passengers, and also makes it impossible for baggage to be spilled into the passenger compartments.

This type of plane is equipped with a lavatory including wash basin, toilet, towel racks, and mirrors.

Pilots enter their forward compartment through a door in the floor and without passing through the passenger cabin. The ladder for this entrance folds back under the ship when not in use. The courier is seated in the anteroom behind the passenger cabin.

Altogether this new plane meets admirably the requirements of passenger comfort which we have discussed previously.

One of the best known passenger planes is the Ford tri-motor which is used by the Maddux Air Lines, the National Air Transport, the Stout Air Service, and several other organizations. This plane has the distinction of being the only multiple-engined passenger plane in America constructed entirely of metal. With three Wasp engines it has a high speed of 130 miles per hour, weighs 6700 pounds empty, and has a useful load of 4100 pounds with seating capacity for 12 occupants.

The Fokker *F-10* super-trimotor, equipped with three Pratt and Whitney Wasp engines of 425 horsepower, used by Pan-American, Western Air Express, and other airlines, took the world by storm when it made its first appearance. It is probably the fastest plane of its size in the world, having a maximum speed of approximately 150 miles per hour, and a cruising speed of 125. Its cabin is the last word in luxury, having specially constructed lounge chairs fitted to the full-vision windows, running water in a complete lavatory, toilet facilities, special compartments for personal baggage, buffet facilities, et cetera. It accommodates 12 passengers with an operating crew of three.

The amphibian gear is hydraulically operated and can be retracted in a few minutes. Carrying eight passengers and two pilots, the plane has a top speed of 128 miles per hour with two of its engines functioning. The weight empty is 5875 pounds; gross weight is 9175 pounds. The area of the wings (the wing cellule is termed a sesquiplane because the lower wing is so much smaller than the upper) is 720 square feet.

The Sikorsky twin-engined amphibian is another famous passenger plane. It is used by Pan-American Airways between Miami and Nassau, and by Western Air Express between Los Angeles and Catalina Island, as well as by other operators, and is giving splendid service. The Sikorsky *S-38* has a short boat hull which makes for lightness, and the tail surfaces are carried on a form of outrigger from the upper wing. The amphibian has again and again demonstrated its ability to fly on one engine. The design of the two vertical tail surfaces is partly responsible for this. They are placed in the slipstream of the engines and are cambered only on the side where they face one another. As a result, when one engine fails, the slip stream of the other engine automatically produces a side force on the tail surfaces in its rear, which counteracts the eccentric thrust of the propeller.

Our transport companies are extremely proud of their pilots. They are hardy, courageous young men, who have been "through the mill," either as Army fliers or airmail pilots or both. It is now fashionable to put them into natty uniforms like those of the T. A. T. pilots in our photograph. There are very specific reasons why pilots are being put into uniforms. People on the ground are apt to resent advice from a pilot whom they cannot distinguish from any other individual. From a man in uniform they will gladly receive warning of a dangerous propeller. The uniform should also help to maintain the dignity and *esprit de corps* of the pilot. Another useful touch is calling the chief pilot Commodore and the pilot of each plane Captain.

Mr. C. M. Keys predicts, "There will grow up in this country a large class of pilots that is now represented by a handful of men on the great airmail lines of the country. These men will be as familiar with the country over which they fly as your locomotive engineers operating on short lines of the main-line railways of the country. They will know every high tree, every wire, every grain elevator, and every church spire along their right-of-way. They will be trained to a rigid discipline that will not allow variation."

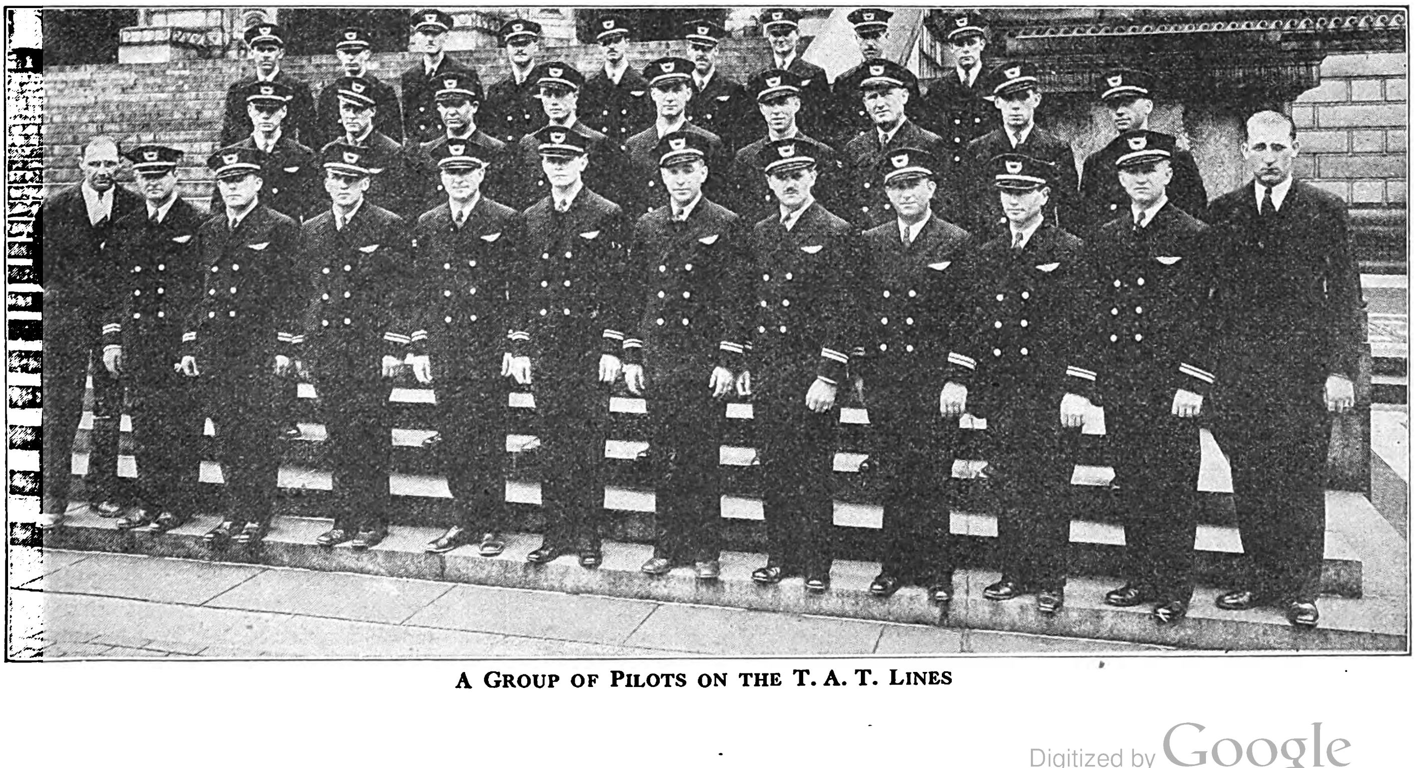
PEOPLE frequently say that the pilot will ultimately sink, as equipment improves and experience increases, to the level of an aerial chauffeur. We doubt this very much. In fact the most serious problem for air transport will be the provision of a sufficient number of well trained men. There are real disappointments in store for the young men who take a short ten-hour course of flying instruction, and expect that they are in line for positions on transport lines, with possible earnings of six to seven thousand dollars a year, when the pilots of T. A. T. have each an average of flying time of over 3000 hours.

It may be of interest to our readers to know the requirements of the Department of Commerce for a school which trains Transport Pilots: such a school must give a minimum of 200 hours total flying time, of which at least 35 hours is dual instruction, and including time on two types of planes other than those used for dual instruction. Students must also be given solid instruction in air commerce regulations, engines, and airplanes, including history of aviation, theory of flight, nomenclature, aerodynamics, rigging, meteorology, aircraft instruments, shop practice, and so forth.

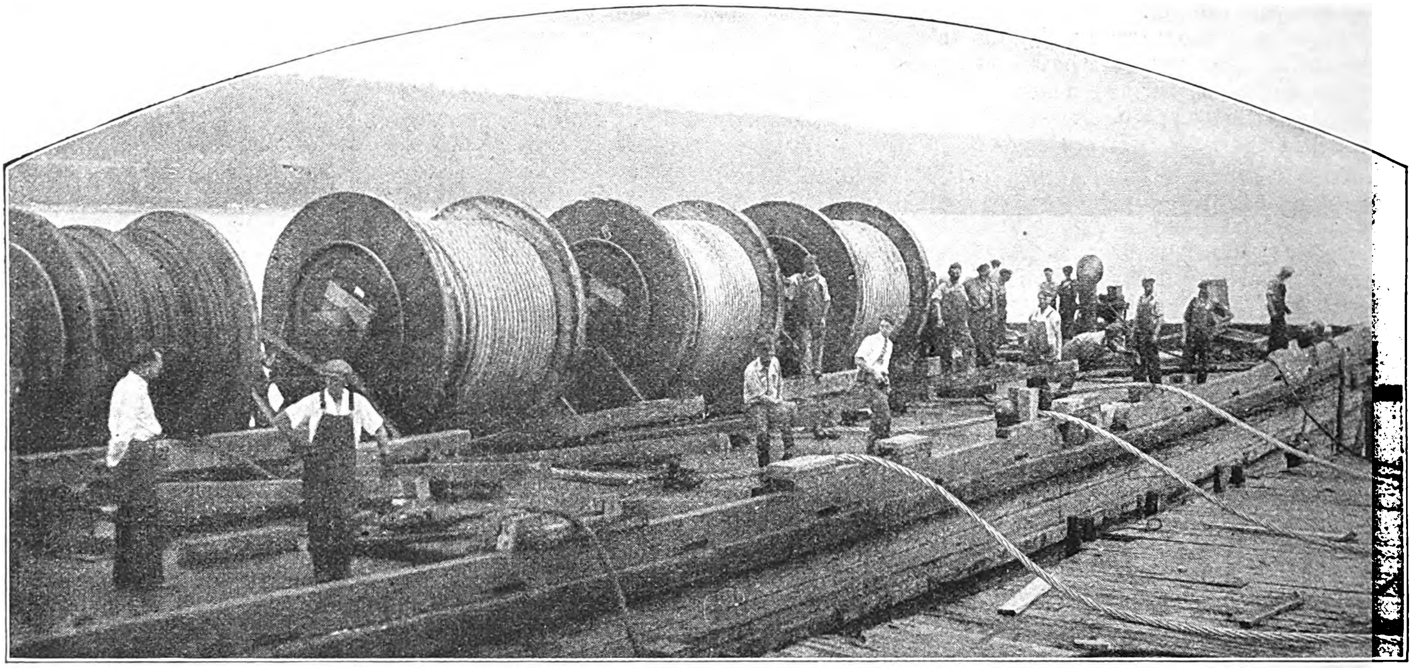
Probably a minimum of 500 hours will be needed before a pilot can graduate from the position of assistant pilot to chief pilot on a passenger machine. It is probable also that all transport pilots will receive instruction in blind flying, where a man is required to fly a plane over a ten-mile course with his view of the ground cut off, using only his instruments to guide him, while a second pilot checks the route.

One of the main difficulties that American air transport has had to face was the lack of an airport close to the center of New York City. This lack is rapidly being remedied, and innumerable airports have been, or are being constructed in cities both large and small. The first stage in the evolution of the American airport was a more or less level field, with a hangar and a large sign board. The second stage was a large, splendidly equipped landing field, well located geographically, with the long and well prepared runways, completely equipped hangars and shops, good field illumination, and service systems including fire protection, heating and ventilation, lighting of buildings, water supply, fuel and oil supply, signal and communication systems, weather service, et cetera, which is deserving of an A rating from the Department of Commerce. The next stage will have to be, if passenger travel is ever to become popular, the provision of real air passenger terminals. Colonel Lindbergh, testifying before the Joint Committee on the Washington Airport, was of the opinion that in this regard

(*Please turn to page* 548)



A GROUP OF PILOTS ON THE T. A. T. LINES



PREPARING TO STRING THE CATWALK CABLES ON THE HUDSON RIVER BRIDGE

Reels of wire ropes were mounted on barges and, after their ends were anchored, were paid out and allowed to rest on the bottom of the river as the barges were towed across. They were then lifted to the tops of the towers. Catwalks were completed late in September

Wires and Cables for a Great Bridge

Manufacture of the Wires for the Cables and Suspender Ropes of the Hudson River Bridge, New York City

By A. E. CRIPPS*

PROGRESS has been called the highway of human endeavor bridging the gap 'twixt past and future. Retracing our steps on this highway, we find that nearly a century ago, in 1831, John A. Roebling, a young civil engineer, left Saxony in Germany, arrived in America, and settled in Pennsylvania. A man of vision, a disciple of progress, it was he who first introduced the art of wire-rope making to this country. From the designing of ropes for canal portages and inclined planes, he graduated to the erection of small suspension bridges.

In 1856 the Niagara Bridge, made possible by Roebling's vision, was opened to the public. This was followed by others of increasing length until, in 1867, the Cincinnati-Covington Bridge, with a span of 1057 feet, was completed, after the pioneer had surmounted opposition and difficulties that would have dismayed any other than an enthusiast.

As early as 1865, plans had been drawn for the erection of a suspension bridge between the cities of New York and Brooklyn. Engineers scoffed and technicians derided the idea. It seemed beyond engineering reason to suppose that wire could support a span of 1600 feet at a height of 135 feet above high water, but again the visionary, with faith in his own ability, triumphed. His plans were approved by a selected board of federal engineers appointed by the President of the United States in 1869. The designer, unfortunately, was not spared to see the completion of the work, for he died as the result of an accident during this same year, on duty at his post while placing the site for the base of the bridge tower on the Brooklyn side. Work began on the foundations for this tower on January 3, 1870, and the enduring monument of granite and wire was completed by John A. Roebling's son, Colonel Washington A. Roebling, despite numerous difficulties and prejudices.

IN 1883, with fitting ceremonies attended by both federal and state officials headed by President Arthur, there was opened to the public what was then the eighth wonder of the world: the Brooklyn Bridge.

Years have passed, and during those years American ingenuity has gone from triumph to triumph in the art of bridge building. The East River has been spanned thrice since by the Williamsburg, the Manhattan, and the Queensboro Bridges. The two former are suspended by cables made from Roebling wire. The Hudson River has been spanned at Poughkeepsie and at Bear Mountain. From the linking of cities we have progressed to joining the highway systems of sovereign states.

On July 9, 1929, the first footbridge cable was raised from the bed of the Hudson River and lifted to the top of two towers, one at Fort Lee, New Jersey, and one at Fort Washington, New York. The engineering marvel of the century had become more than a dream. Two great states had another mutual bond—the Hudson had been bridged.

To obtain an idea as to the immensity of this project one must necessarily draw comparisons. The Brooklyn Bridge took 13 years to build and cost 25 million dollars. The new Hudson River Bridge will be completed in a space of five years and will entail the expenditure of 60 million dollars. The former has a span of 1600 feet supported by four main cables, each with a diameter of 15½ inches and each composed of 5296 wires weighing 900 tons. The latter has a span of 3500 feet with four main 36-inch diameter cables, each weighing 7125 tons. Each of these cables is composed of 61 strands, each containing 434 wires, making a total of 26,474. The towers of the Brooklyn Bridge are 295 feet high, while those of the Hudson River Bridge are approximately 635 feet, or nearly a hundred feet higher than the Washington Monument.

---

* Of John A. Roebling's Sons Company

Of course, with the march of progress, certain methods of construction used at the time the Brooklyn Bridge was erected have now become obsolete. These old methods have been improved upon to meet existing conditions, since the magnitude of the new project was inconceivable until recently. Without considering the ropes used in preliminary construction work, the main cables will total 57,000,000 pounds of galvanized wire, each wire having a diameter of .195 inches—nearly the thickness of a lead pencil—or 106,000 miles of wire, enough to go around the earth at the equator more than four times. The John A. Roebling's Sons Company, still operated by the sons and grandsons of the pioneer bridge builders, are manufacturing and installing these four 36-inch main cables, and are also furnishing and erecting the anchorage materials.

MOST of the wire to be used has already been manufactured, and is now in storage at the plant at Roebling, New Jersey. The stored wire covers an area of 30,000 square feet, and is stacked 8 feet high—enough to cover a New York City block to a height of two feet.

The production of steel wire for the four cables of this mighty bridge is no small task when one considers that the seven large suspension bridges in this country do not contain sufficient wire to fabricate the cables for the Hudson River Bridge, and yet this quantity of material will be produced within the specified time and not interfere with the normal production of the plant.

Steel for this wire is made by Roebling in 40-ton acid open-hearth furnaces. When this refined steel reaches the proper chemical composition, it is poured into ingots 14 inches square and five feet long and allowed to cool slowly. After re-heating, these ingots are rolled into two-inch by two-inch blooms which are cut into 30-foot billets. These are reheated and rolled into round rods in a new, continuous-rod mill costing 2,000,000 dollars.

After rolling, the rod is put through a normalizing process, cleaned in acid to remove the scale, and thoroughly washed, following which it is neutralized in lime and finally baked in ovens to prepare the steel rod for the cold wire-drawing operation.

IN the wire-drawing operation cold wire is drawn through alloy steel dies of successively decreasing diameters until the correct diameter of .192 inch is obtained. After drawing, the wire is given another thorough cleaning operation to prepare it for the galvanizing bath where it receives a coat of pure zinc averaging about .002 inch in thickness which thoroughly protects it from the elements. It is then wound into coils five feet in diameter, there being about 4000 linear feet of wire in each coil. Although this wire has received thorough inspection prior to its finished state and has been tested as to its chemical composition and physical properties, it must now meet severe and thorough testing in its finished state before final acceptance; that is, ultimate strength, elastic limit, ultimate elongation, and bend test requirements must be met before the wire is accepted and placed in storage. Every coil must meet these requirements. This means that half a million tests must be made to secure this quantity of material.

When the material is required at the bridge site the individual coil is rewound on steel reels, each of six-foot barrel diameter, three feet wide, and containing 160,000 feet of wire. The individual coils are connected together by means of a special threaded connection that develops practically the full strength of the wire and makes possible a continuous wire of any length.

Special machinery has been designed by the Roebling Company to speed the reeling of the wire and to eliminate excessive manual lifting and hauling of these heavy reels. This is all accomplished electrically with a minimum of effort on the part of the machine operator. A description of the various inventions that have been developed by this company for the production and spinning of the cables for the new Hudson River Bridge would require a book to put forth, this article being too limited in its scope to attempt it.

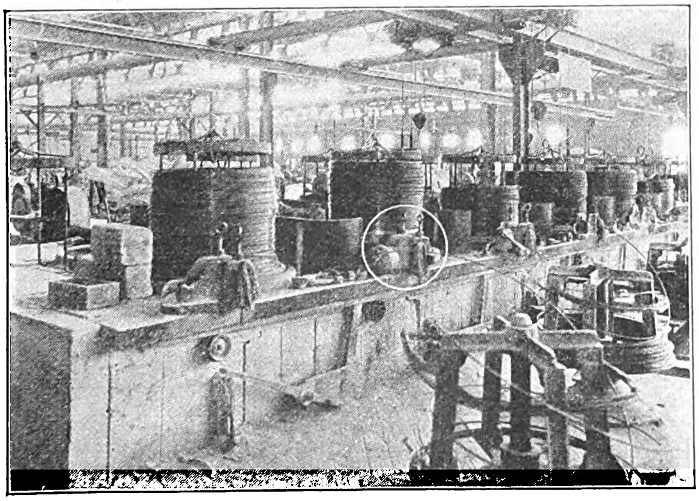
There will be about 4000 reels of wire necessary and special gondola cars have been built to carry them to tidewater. Here the cars containing the reels are transferred to car floats, and taken by means of tugs to the bridge site. From the river level they are hoisted by aerial tramways which have been constructed, one on each side of the river, to storage sheds at the anchorages.

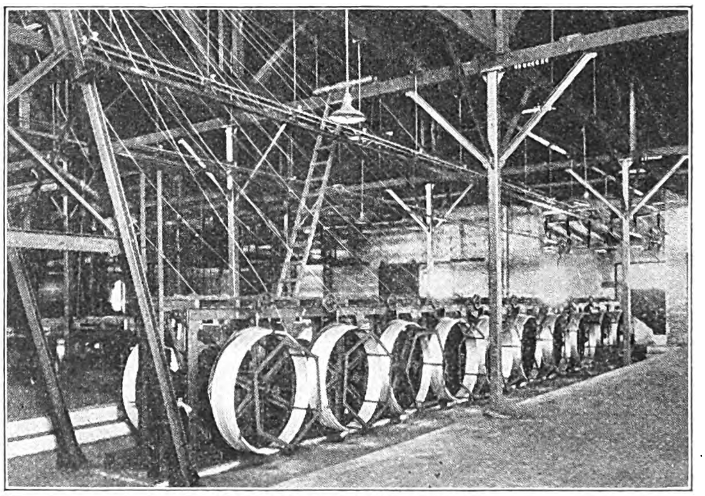
THE anchorage on the New York side is a solid mass containing 110,000 cubic yards of concrete (enough to pave a roadway 18 feet wide and 53½ miles long, or half the length of Long Island) in which are imbedded 1400 eye bars, approximately 40 feet long, each one over one ton in weight. There are 2100 eye bars on the New Jersey side. In all, the eye bars weigh approximately 4000 tons. The towers comprise 40,000 tons of structural steel, riveted together, on which will be suspended the four giant main cables.

There was necessarily an enormous amount of preliminary construction work to be done before the main cables

A WIRE-DRAWING BENCH

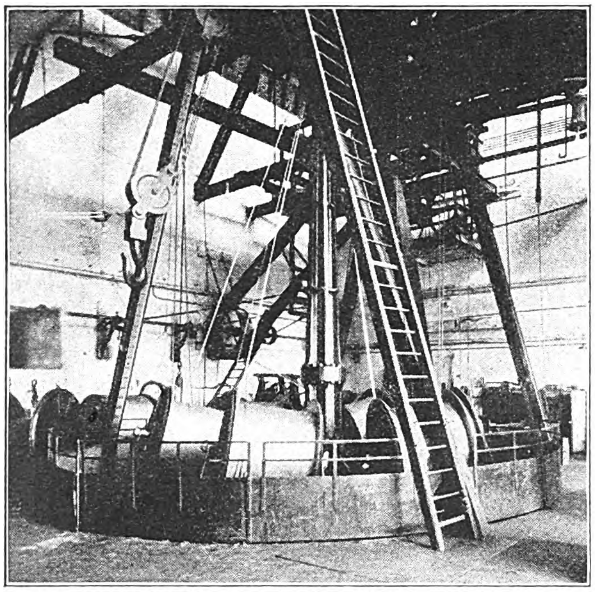
The rod is drawn through steel dies of successively decreasing diameter until reduced to the proper size. Die block is in circle





AFTER GALVANIZING

The receiving end of the galvanizing operations. There are 20 five-foot reeling swifts for each outfit for galvanizing 20 wires



ROPE-CLOSING, OR TWISTING, MACHINE

On this machine, the largest in the world, the finished wire strands are closed into ropes of large diameter

could be spun. After the erection of the towers and the building of the anchorages, temporary footbridges, or catwalks, were erected for the workmen who spin the cables. The catwalks are supported by four groups of cables, each group being composed of nine galvanized 2⅞-inch diameter wire ropes, formed of 6 strands of 37 wires each laid around an independent wire rope center. It is interesting to note that there is as much wire material in the footbridge ropes on the Hudson River Bridge as in the main cables on the Bear Mountain Bridge.

These ropes were manufactured on a mammoth machine that is said to be the largest of its kind in America—if not in the world—which is capable of closing ropes up to five inches in diameter.

To enable the manufacturers to test the footbridge ropes adequately, the world's largest precision testing machine was constructed to Roebling's specifications. This machine is capable of testing wire cables for tensile strength up to 2,000,000 pounds.

AT certain intervals, samples of the suspender ropes—which will hang from the cables and support the bridge floor—are tested on this machine to their breaking point. A strain equal to approximately 1,360,000 pounds is applied before the final parting of the rope is accomplished. This is many thousands of pounds above the necessary specified strength.

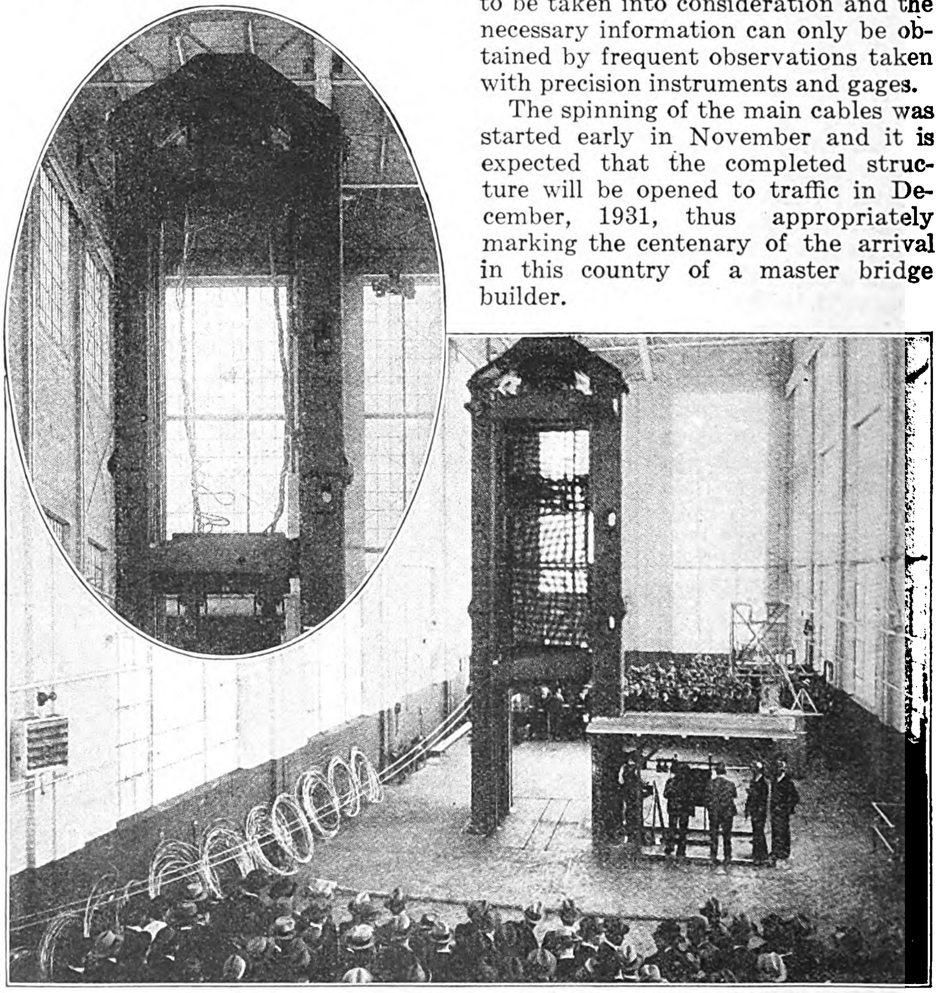
In the placing of the footbridge ropes from one anchorage to the other, an entirely new method was adopted. Heretofore the rope, in one continuous length, was made fast to one anchorage, lifted over the tower, then towed across the river on a barge, lifted over the other tower and then fastened in the other anchorage. In this case the rope was made up in three separate sections, one for each of the land spans, the ends being fixed at the two anchorages, and the other for the main span which is laid on the river bed. These three sections were joined together by means of a special rope link at the bases of the towers, and, at a given signal, cranes operating on the tops of the towers and working in unison, picked the rope up from the bottom of the river and lifted it to a position in a temporary saddle on top of the tower. The footbridge ropes hang at the proper deflection, since they determine the position of the completed main cable.

After the placing of the footbridge ropes, tramway ropes were strung across the intervening gap from anchorage to anchorage, these being used for the transportation of erection materials and for the spinning of the cables. Following this, the wood and steel footbridge sections were placed in position and clamped securely to the ropes; hand rails and wire netting were then added for the protection of the workmen, and all was ready for the spinning of the main cables. It is interesting to note that after such footbridge ropes have served their purpose, they are reeled and cut into lengths to form the suspender ropes between the main cables and the suspended structure.

There is a complete telephone system between the various centers of activity on the job, making it possible for one man to talk to another, if necessary, from the top of the 635-feet towers to any point on the job. When the Brooklyn Bridge was built, orders and messages were transmitted by means of flag signals.

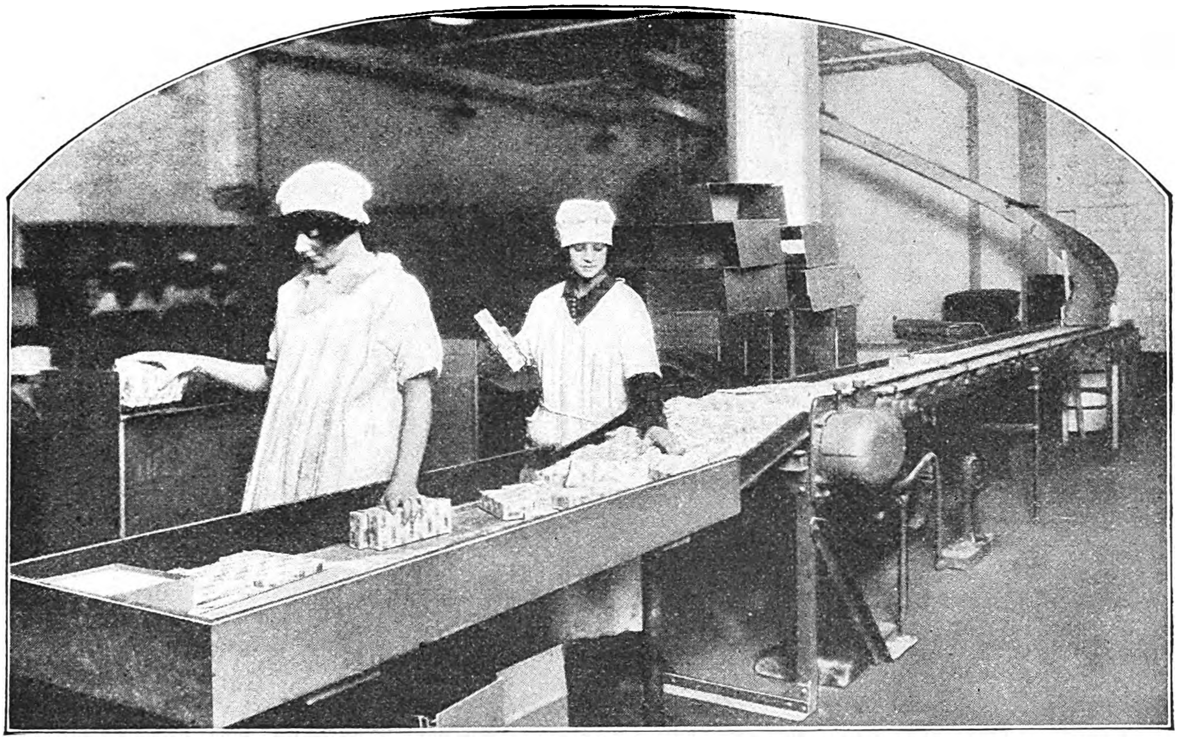
EACH tower is also equipped with an elevator running to within 50 feet of its summit. These will be a permanent installation. A staff of engineers is residing in bunk houses on the site so that they are in close touch with developments 24 hours of the day. Observations on the cable deflections according to temperature are made at varying hours since changes in temperature cause the steel cables to expand and contract so that there is an appreciable rise and fall of the roadbed from times of winter cold to those of summer heat. This, of course, all has to be taken into consideration and the necessary information can only be obtained by frequent observations taken with precision instruments and gages.

The spinning of the main cables was started early in November and it is expected that the completed structure will be opened to traffic in December, 1931, thus appropriately marking the centenary of the arrival in this country of a master bridge builder.



MACHINE WHICH SNAPS HUGE WIRE ROPES LIKE THREADS

The largest precision testing machine in the world, capable of exerting a pull of 2,000,000 pounds, in action before The New York Electrical Society. ***Inset:*** **two ropes breaking in test**



MILLIONS OF MINTS READY FOR SHIPMENT

Sealed cartons being delivered at the end of a spiral chute leading from the floors above, where the various flavors of round tablets are automatically manufactured, wrapped in foil and paper, and packed in sealed cartons

Rebuilding a Broken Business

The Story of the Development Through Research of a Huge Candy Industry

By MILTON WRIGHT

WITH all the thousands of things there are to eat, drink, chew, or roll around in the mouth, the favorite flavor of the Great American Public is peppermint. Just why this is so, nobody seems to know, although there are many theories. One is that it revives childhood memories, peppermint candy for generations being the one kind parents have given their children most frequently. It is the one kind, moreover, that has attracted young children most strongly, because the old-fashioned bright red and white sticks, like miniature barber poles, appeal vividly to the eye.

Then, too, there is nothing backward about the taste of peppermint. When you taste it, you know you are tasting something, no matter how atrophied your sense of taste may have become. Also—and this accounts in no small measure for peppermint's popularity—there is a lasting, penetrating, but pleasant aroma about peppermint that drowns out lingering traces of other things that have been consumed.

Whatever the reason for the popularity of peppermint flavor, the fact is that a great industry has grown up to supply the insatiable demand of the public for mint-flavored confections, an industry which, for efficient manufacturing methods and clever sales distribution, is second to none. Despite its proportions, however, it is an industry that has developed into the million-dollar class in the last ten years. Only a few months ago a mint confection business was sold for twenty-two million dollars. Yet 15 years ago this business was started with a capital of $900.

TO learn how candy mints are made, we journeyed to the biggest factory of the kind in the country—the Life Saver plant at Port Chester, New York. As in many modern factories, we found production accomplished by the oldest, simplest, cheapest, and most efficient method man has yet discovered—the gravity process. Up to the roof of the building go the raw materials. Down they come, rolling, sliding, tumbling, falling, passing through this piece of apparatus and that, until they emerge on the second floor, a finished article, wrapped, and in cartons ready for delivery. In all the process no hands have touched them.

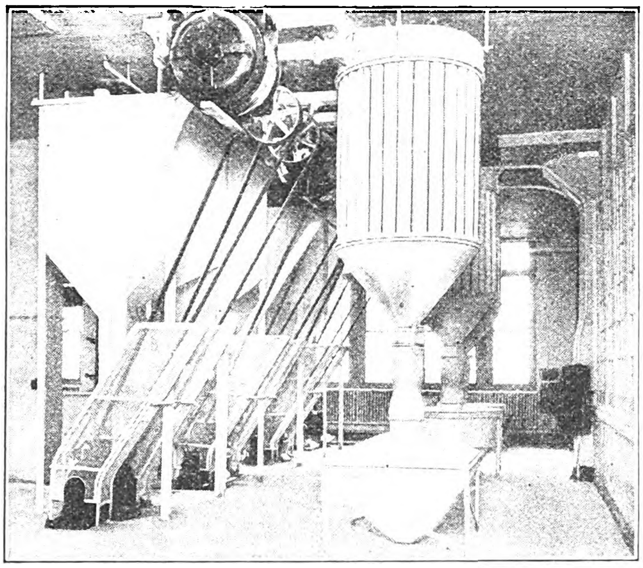
The raw materials are sugar and mint flavor—nothing else. Granulated sugar received in barrels is emptied into a conveyor near the receiving platform on the first floor. A continuous bucket elevator carries it to the roof where it is stored in hoppers until used.

The first manufacturing step is pulverizing the sugar. Standard pulverizers located on the fifth floor do this job. As soon as the sugar is powdered, it drops into mixers on the fourth floor. From the mixers it is put through a special form of granulator which delivers the mass of sugar in the shape of small kernels on to moving belts which lead to elevators. Here the kernels are deposited into drying units, and the whole mass is dried before being deposited into blenders, where the flavoring oils are added.

A completely equipped laboratory is maintained at the plant, where the flavor is prepared and measured out into containers, so that for each batch of 200 pounds of sugar mixture, a uniform amount of flavoring oil is added in order that each batch may be exactly like every other.

From the blenders the mass is fed into batteries of rotary tablet-forming machines on the third floor. To every tablet a pressure of 14,000 pounds is applied, giving it a china-like hardness.

There is an old "wise-crack" to the effect that the manufacturers of Life



PULVERIZING THE SUGAR

Granulated sugar must be powdered in pulverizers before it is ready for the mint-compressing machines

Savers make their money not out of the confection, but out of the hole, or rather out of the sugar saved by having a hole. The fact of the matter is that the high pressure forces as much sugar into a small space as would fill a larger space at more moderate pressure.

After the mints are formed, they are delivered to automatic wrapping and packaging machines, also on the third floor. It took eight years to develop these machines, but now, it is believed, they are as nearly perfect as human ingenuity can make them. Each machine wraps and labels an average of 1000 boxes a day, running at an average speed of 35 to 40 rolls a minute. These machines receive into their hoppers mints in bulk direct from the tablet forming machines. An aligning device turns them on edge and assembles them into rows of 14 each. The assembly completed, each group of 14 is gripped by steel fingers which carry them on to a piece of tin foil which has been cut to the desired length from a big spool of foil beneath the machine. The tin foil is then spun around the candy and the ends twisted.

NOW comes the affixing of the label. This is applied in the same manner as the tin foil, except that to make it secure, instead of twisting, a small strip of vegetable glue is applied along one side. Assembled and wrapped, the packages are deposited on a belt conveyor which delivers them to packers.

At this point on our trip through the factory, we felt impelled to ask a question: "Why not have machines pack the rolls in cartons? It ought to be no more complex than some of the other things you accomplish."

"Machines have been perfected for such a task," was the reply, "but as yet no machine has been devised which will insure each package being laid in the carton so that the trade mark and flavor name on the label are uniform in appearance and can be seen when the carton is opened. That is a problem yet to be solved by some invention. It means a lot to have a perfect and uniform display of the cartons and their contents on dealers' counters."

With placing the rolls in the cartons, the trip of the sugar down from the roof is not completed. After packing, the cartons are carried on a belt conveyor to a wax sealing machine. Here a paper, waxed only on the outside, is wrapped around the carton and the end folded in a peculiar manner. The box now passes through an electric heating unit, which melts the wax just enough to cause a tightly sealed package when the wax congeals again.

Through spiral chutes the finished cartons drop to the second floor, where the individual cartons are packed. Those for domestic use are packed into fiber shipping cases and those for export into wooden boxes.

We hunted up the president of the Life Saver Company, Edward J. Noble, who is credited with having created the mint market in this country.

"Why is there so much industry and so much business in such a little thing as a life-saver tablet?" we queried.

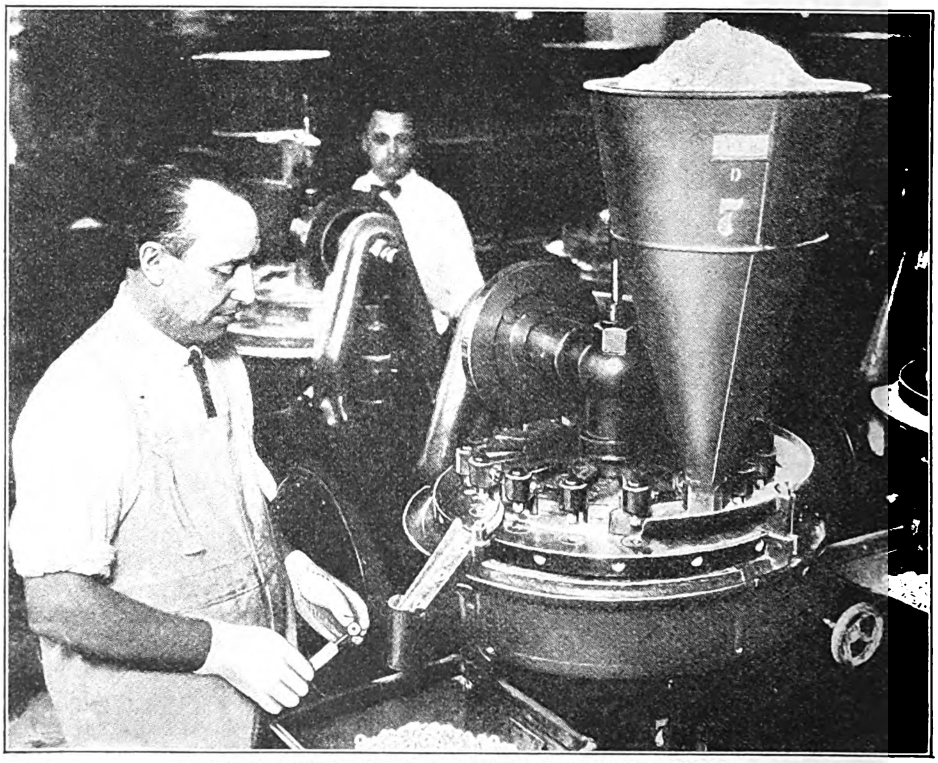
"Well, our sales manager, Mr. M. B. Bates, who is supposed to know about the psychology of such things, says it is due to a national idiosyncrasy," he replied. "It is the result of a trait our ancestors acquired down on the farm. A man used to walk along chewing on a straw. At a later date a lot of people developed the gum-chewing habit—many of them still have it. At a still later date we got the habit of rolling a mint tablet around under the tongue."

"We have heard that when you took over this business 15 years ago it was a failure. Do you attribute your present dominance in the field to the fact that you have improved the quality of your product?"

"NOT at all. As a matter of fact, the product is just the same as it always was, even when the public wouldn't use it. A mint tablet is nothing but sugar and flavoring pressed together. From the standpoint of ingredients there was nothing to improve."

By dint of long questioning we finally got at the secret of it all. The mint-tablet industry, we learned, is a child of the candy business, but now grown to manhood and prospering on its own account. Clarence Crane, manufacturer of Crane's and Mary Garden chocolates, had started it in Brooklyn as a summer specialty. It kept his force of workers intact in months which are no time to be boiling sticky chocolates.

Managed as a side line, it was not a paying proposition. Noble and a friend, J. Roy Allen, bought it for a

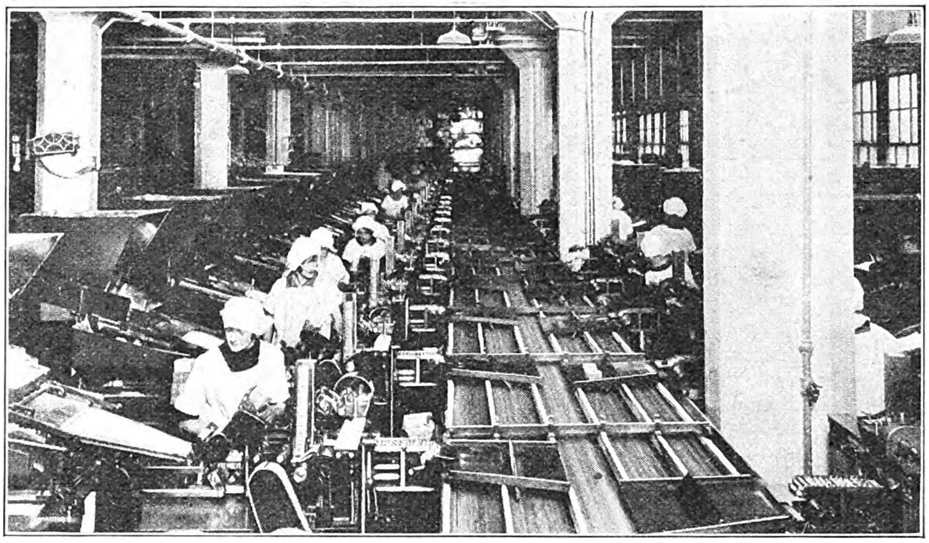


WHERE THE PEPPERMINTS GET THE HOLE

Compressors moulding peppermint flavored tablets in the familiar "life-saver" shape; a pressure of 14,000 pounds is applied to each, giving it china hardness so it will dissolve slowly song and with a capital of nine hundred dollars started in business.

"We had staked all our money, our reputations, and our future on the shape of these confections, but we found the candy stores wouldn't have them," Noble told us. "Dealers had tried them and felt they had been stung. We had to build from the ground up and not only that, but we had to find new ground to build on.

"The mint tablet, we found, was good when it left the factory, but it spoiled after two weeks. A careful study of the matter convinced us that the trouble lay in the packing. The cardboard tube in which the mints were packed absorbed the flavor and in time imparted its own unpleasant taste to the candy. We considered various kinds of wrappers and at last hit upon tin foil. In the first place, a little pressure would seal it; no paste was needed. In the second place, it would hold all the flavor and had no flavor of its own to impart. In the third place, the mints stayed in securely, but came out easily, one at a time, when you wanted them.



BATTERY OF AUTOMATIC WRAPPING MACHINES

From the pulverizers on the top floor of the factory, through the various steps to the final wrapping, no human hands touch the mints. Here they are being assembled and wrapped

"NEXT we changed the name. Instead of peppermint we took the name Pep-O-mint. This had a two-fold advantage. It helped to remove the curse from the old product that the dealers wouldn't have, and it gave us the type of name we could adapt to other flavors, like Vi-O-let, or Wint-O-green, or Cl-O-ve, as the business grew.

"So far, our efforts had been directed to the ultimate consumer. Now we had to turn our attention to the dealer. We changed the style of carton. Instead of packing 36 in two rows, we packed 18 in one row. We also designed the carton so that when the cover folded back it formed an easel. This made an attractive display case which the dealer was glad to place on his counter."

"Did the dealers take to the new idea?"

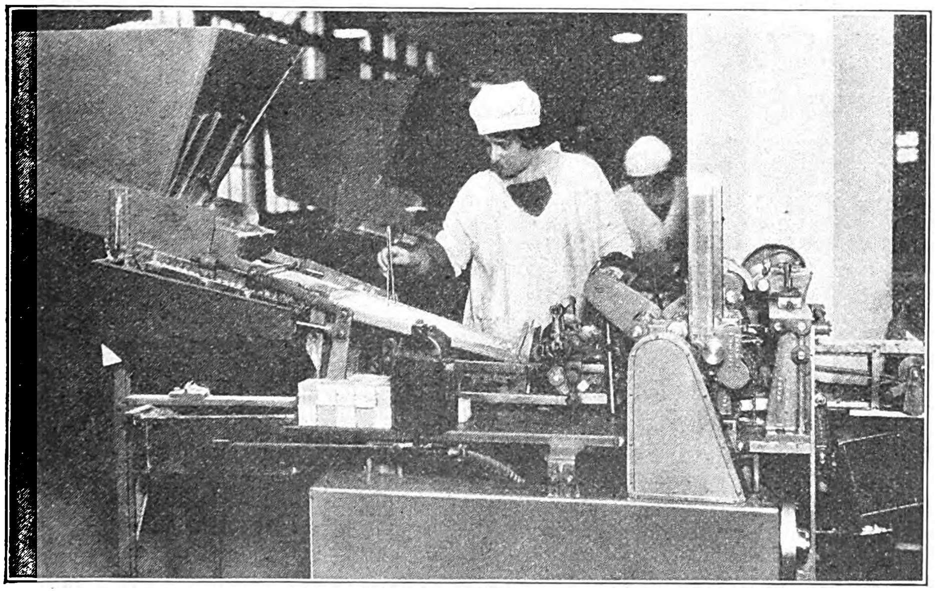
"Not right away. They still identified us with the old article that wouldn't keep. Jobbers wouldn't handle the product. The only thing for us to do was to find new outlets—places where mints had never been sold before. These we found in places frequented by men—cigar stores, bowling alleys, billiard rooms, and the like. It may surprise you to know that 60 percent of the mint tablets made in the country are consumed by men. In all, we developed 17 new outlets. After they had been operating successfully for some time with our product, the candy stores fell into line and our distribution problem was solved."

"But all this took time. Didn't it mean a lot of money going out before any was coming in?"

"No, the business paid for itself from the start. We worked on the principle of taking some profit on every transaction and we never ventured a positive money risk. In the beginning we had a manufacturer make the mints for us. Our first order was for 1000 cartons a week. By the end of the first year we were ordering 6000 a week. Our net profit that first year was one hundred and fifty-nine dollars. Then we began to manufacture for ourselves. We progressed steadily until we dominated the industry."

"What steps would you say a man should take when embarking in a new manufacturing enterprise such as yours was when you took hold of it?"

"First, be sure your product is right. Second, be sure the surrounding detail is right. Third, study your market completely. Then go in for scientific manufacturing methods, and after that your success will depend largely upon business ability and hard work."



APPLYING THE TIN FOIL AND WRAPPER

Rolling like wheels into the automatic package-wrapping machines, the candies are assembled in groups of 14, rolled in tin foil, and covered with a wrapper denoting the flavor

OF course the candy business is like any other in which the consuming public is the deciding factor; the task of temporarily appeasing a sweet-tooth is mostly a matter of psychology. The imagination of the public has responded to the Life-saver idea because of the characteristic shape and name of the confection. The demand for the little mint with the hole has been sustained and enlarged by astute advertising methods.

The importance of sales psychology is attested by James Somerville, trade commissioner of the Department of Commerce in London, who points out that sales of candy abroad are affected by the fact that residents of the United Kingdom have a decided prejudice against eating in public. For this reason manufacturers encounter difficulty in marketing candy bars of the type popular in America, although there is a vigorous demand for packaged candy put up for consumption in the home, and also for the less noticeable confections that can be eaten anywhere, such as candy-coated chewing gum, lozenges, and mints.

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

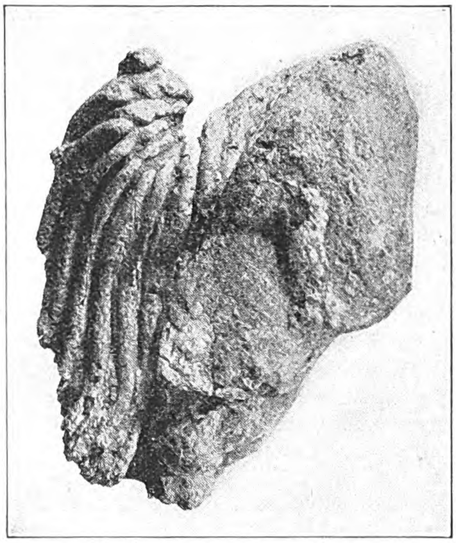
A Mammoth's Deformed Wisdom Tooth

ELEPHANTS, ancient and modern, have had dental troubles for a long time. Fossil mastodon and mammoth teeth have shown pyorrhea, cavity formation (dental caries), abscesses, and now we know they had impacted molars. The tooth shown here is from the largest of all the elephants, the animal standing over 13 feet at the shoulders. This tooth, eight inches high and weighing 25 pounds, was not able to erupt properly, and became impacted and badly twisted. The plates forming the flattened crown, to the right, are at right angles to the plates shown on the left. It is a mammoth's impacted wisdom tooth, discovered in the Pleistocene deposits near Corsicana, Texas.

Life Saving by Mechanical Respiration

THE Schaefer method of respiration for resuscitating victims of asphyxiation, submersion, electric shock, et cetera, has been in use for many years and has proved its worth many times over. In the past, its successful use depended upon an appreciable amount of training because the method has been usually applied by manual means, and the results, therefore, were influenced by the human element and were not always satisfactory. Now, however, with a new apparatus recently introduced from France, which is easily portable since it weighs but a few pounds, the method may be applied mechanically by any person regardless of his training in resuscitation methods.

The Mechanical Resuscitator, as it is called, consists of a slightly inclined rest upon which the chest of the victim is to be placed, his legs extending outward on the floor to the rear, his head resting upon a curved, leather-covered plate at the top of the incline, and his arms on the two side "saddles" shown in the accompanying illustrations. When he is placed in this position, wide straps, which are attached to the movable side bars, are buckled together over the small of his back. The apparatus does not interfere with the use of an oxygen mask which is necessary in cases of monoxide gas poisoning nor does it prevent vomiting or the expulsion from the mouth of any foreign substance which might impede respiration.



Fossilized impacted molar of a mammoth which shows that these beasts suffered from tooth-ache

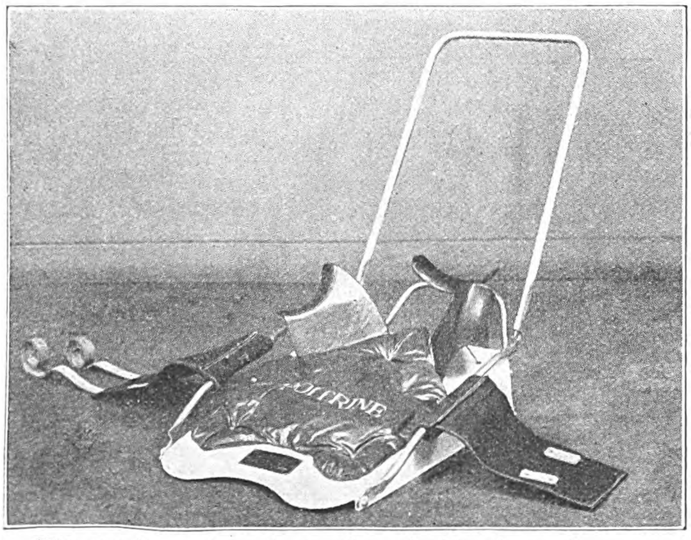
In operation, the handle which is connected to the side movable bars is pushed down gently, this action lowering the shoulder supports and lowering the side rods which, in turn, pull down the strap which compresses the patient's lungs. When the pressure on the handle is released, powerful recoil springs lift the side bars and therefore release the pressure on the lungs while at the same time lifting the shoulder supports so that the lungs are allowed to expand and inhale. When the rhythm of the pumping motion is timed by the breathing of the person operating the lever, the result is that the victim inhales and exhales properly and the likelihood is that he will have a better chance of recovery than if the Schaefer method is applied manually.

As may be seen from the photographs, the apparatus is so simple that even a casual life saver can make no mistake in its operation. The word "chest" on the apparatus (in our photograph, the French word *poitrine* is shown) and the rests provided for the armpits and the head indicate the postion in which the patient is to be placed and prevent any possible error.

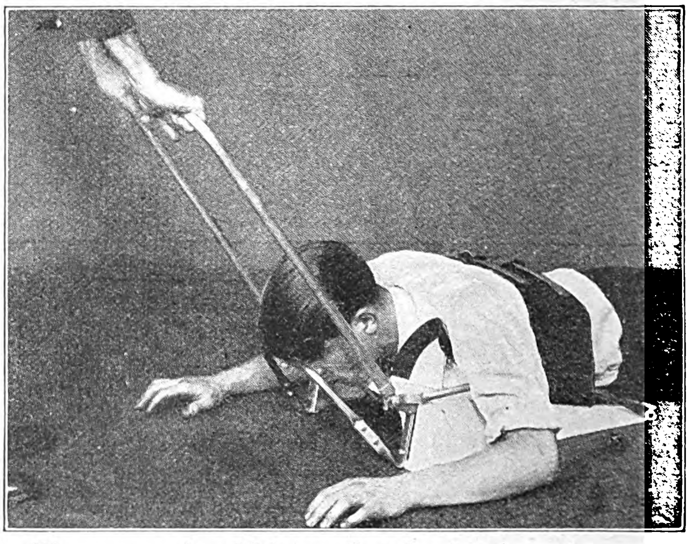
Railway Snow-shed Fire Fighters

THE fire hazard of the extensive wooden snow sheds in the Sierras, exposed from without to forest and brush fires and from within to sparks from locomotives, is responsible for the fact that the railroad owner of the snow sheds possesses a fire department that is perhaps the most unusual in the world. It includes fire trains, lookouts, patrolmen, and alarm systems, all having their well-defined duties.

The fire-train service consists of four trains located one at each end of the snow shed district and two at points of vantage in the shed. Trains are made up of standard 10-wheel locomotives and two water cars carrying from 20,000 to 30,000 gallons of water. This is enough to supply the 300-gallon-per-minute pump for an hour and a half at full pressure. Each one carries a thousand feet of hose and a full equipment of ladders, axes, buckets, and similar apparatus. Engines are kept with steam up at all times and crews are on duty day and night. There has never been a failure of the equipment to stop a fire at the point it was encountered on the arrival of a train. What losses have been sustained, therefore, are measured by the speed with which the alarms are given and responded to after a fire is discovered.

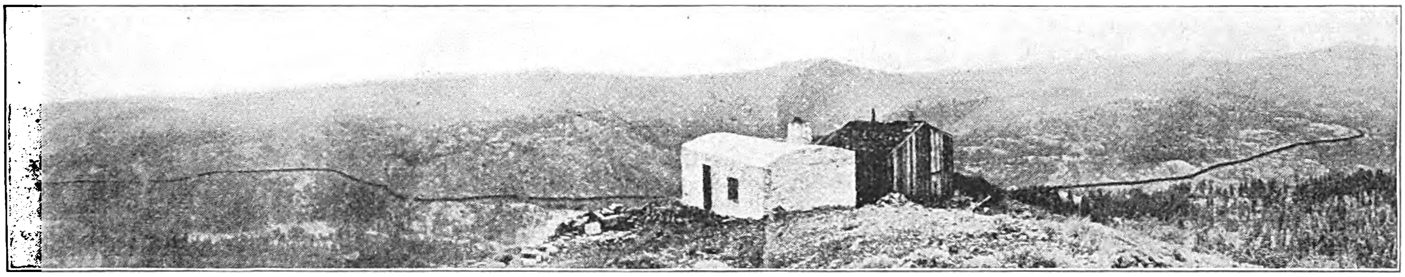


The mechanical respirator described in these columns. Head rest, shoulder saddles, and chest (*poitrine*) pad are shown. Body straps are connected to side bars



The manner in which a patient is placed on the mechanical respirator for treatment. The handle is pumped up and down with a gentle rhythmic movement

For communicating fire alarms to the train, the telegraph was first employed and was later superseded by two independent alarm systems, one like that used in cities, with gongs at the fire-train stations and boxes distributed through the sheds, used for fires only; the other a district alarm system with central office in a concrete fireproof building at the summit of the line, to which all watchmen and patrolmen report at regular intervals.


Stone observatory for fire fighters showing snow shed over a railroad in the distance

When it developed that, with watchmen located only in or on the sheds, threatening forest fires could obtain considerable headway before discovery, the necessity for a station from which a bird's-eye view of the whole country roundabout could be obtained was apparent. Such a point of vantage was found on the summit of Red Mountain, or Signal Peak, as the Government calls it. The crest of this mountain, 7860 feet above sea level, commands a view of the sheds for almost their entire length. Here a stone observatory has been constructed, and day and night observers keep watch. To determine the exact location of an observed blaze an ingenious device has been arranged. This consists of a transit, mounted on a fixed pier in the center of a bay window, and a map etched on a silver-plated copper plate located on a table in front of the transit. The shed line on the map is inlaid with black enamel and along this line is indicated in different colors each station, tunnel, mile post, signal box, et cetera. Over this map swings a knife-blade pointer attached to, and coinciding with, the axis of the transit.

The operator at night sits in this window in semi-darkness. On seeing a suspicious light, he sights the transit on it and then presses a button which controls a small electric light illuminating the map and the etched line. A glance through the finder shows whether the fire is above, below or in the sheds, and the position of the pointer shows the exact location on the railroad. If a blaze is from a small campfire too close to the sheds, word is sent to the nearest section headquarters and men are dispatched to move the campers to a safe distance and extinguish the offending fire. In the case of a fire actually in the shed, the fire trains leap into action on the alarm from the observer, those nearest to the fire going directly to the reported scene and the others closing in as in regular fire department service.

Once well started, the fire demon has been known to consume 3100 feet of snow sheds in 35 minutes, entailing a loss of 1500 dollars every 60 seconds. That is why the fire trains race against time when the call comes. Actual records show that very promptly after a fire alarm is turned in fire trains with crews and volunteers are whistling their way to the scene. These fire fighters have been known to stay with the enemy until the headlight was burned off the engine.

As a sample of the accuracy with which even small fires can be located from Red Mountain, the instance is cited of a section foreman who took it into his head to sharpen some track chisels, and, for that purpose, kindled a fire in a small portable forge that was in direct line between the snow sheds and the observatory. This blaze was observed from the lookout and, being apparently in the sheds, the fire train was called, ran two miles, and stopped exactly at the location of the forge before the chisels had been brought to a working heat.

Pecan Oil From Waste

PECAN oil, described by chemists of the United States Department of Agriculture as of very mild, agreeable, and characteristic flavor, is one of the latest additions to the long list of products that are now being manufactured from what were formerly farm wastes.

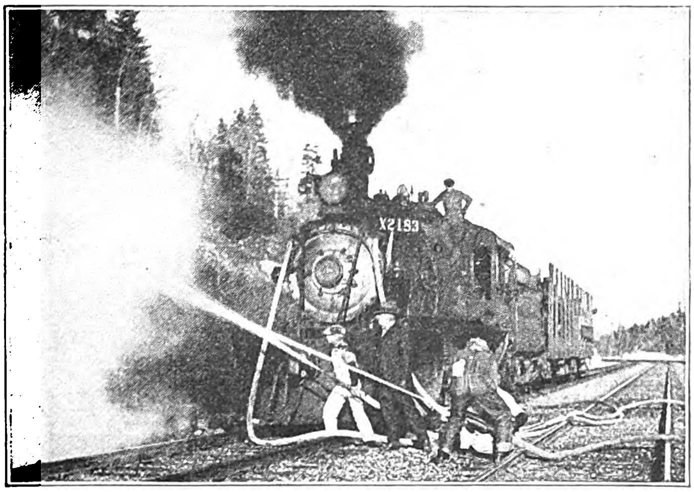
Fine nut fragments accumulate at the pecan shelling plants. Chemists made experimental pressings of this waste and determined the properties and composition of the oil. This oil is of excellent quality and can be used for making salad dressings or other edible products. It is necessary to express the oil before the nut waste becomes rancid, otherwise the oil would not be edible.

Dried Hog Stomach New, Cheaper Anemia Remedy

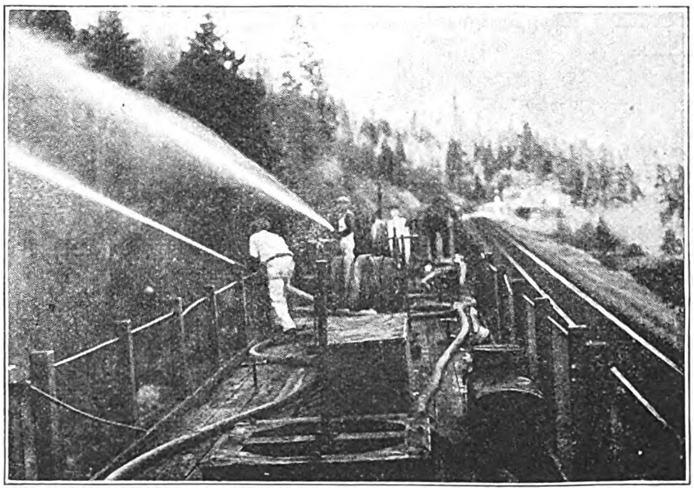
DRIED stomachs of hogs may soon vie with livers as the saviors of sufferers from pernicious anemia. This newest anemia remedy, made from one of the few unused parts of hogs, has just been developed and announced by Drs. Cyrus C. Sturgis and Raphael Isaacs of the Simpson Memorial Institute for Medical Research of the University of Michigan and Dr. Elwood A. Sharp of the Department of Experimental Medicine of Parke, Davis and Company.

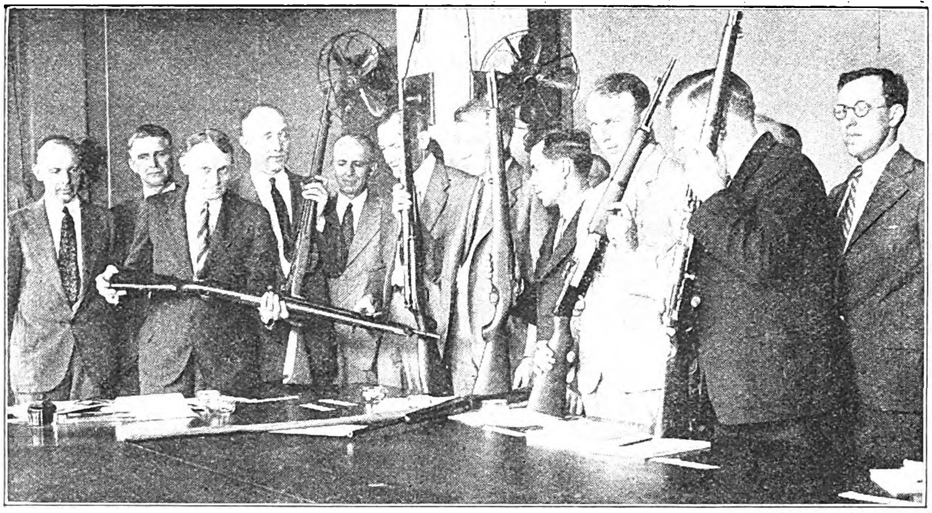
An ounce of extract from the dried, ground stomachs of hogs is said to be as effective a remedy in pernicious anemia as a pound of raw liver or three ounces of the most concentrated liver extract yet made.

This is the latest step in the conquest of a disease, pernicious anemia, which a few years ago was in the category of the unvanquished ills of mankind. In 1926 it was found that by feeding liver to anemia patients, their red blood corpuscles could be increased. Liver, once the poor man's meat, increased in price rapidly. Then the active principle in liver was extracted so that anemia patients could take small doses of the extract instead of eating large quantities of the liver itself. Now comes the new and cheaper source of the anti-anemia principle which promises splendid results.



One of the fire-fighting trains, called into action by the observer in the station shown in the illustration above


The tank and hose car of a fire-fighting train. Smoke from a fire which menaces railroad property is visible



Over a year ago the United States Government called for competitive designs of semi-automatic shoulder rifles. Recently Army and Navy officials met to test the various designs submitted. Brigadier General George E. Simmons, Chief of the War Plans Division, is here shown examining one of the rifles

The new extract from hog stomach is not yet commercially available. But it will be far cheaper than liver or the costly liver extracts on which pernicious anemia patients until now have been dependent. Hogs' stomachs are largely a waste product, finding only slight use in the production of pepsin. The dried extract is practically tasteless and looks something like sawdust particles. Beef stomach and ox stomach are sold as tripe, which is a familar food to many. Hog stomach, which has a different structure, is ground and dried to make the new extract.

An immediate increase in the number of red blood cells took place when this dried hog's stomach was fed to patients suffering from pernicious anemia. The increase was even greater than that following liver treatment.—*Science Service.*

Arc-Welded Steel Motor Boats

THE Engineer Corps, United States Army, are now building three arc-welded steel motor boats for use as carriers and tow boats on the Mississippi River and its tributaries. This is the second fleet to be so constructed. The first fleet of seven was launched over a year ago and have been in continuous service ever since.

The launches are constructed entirely of steel, all permanent connections being made by the electric arc-welding process. The over-all length of each craft is 28 feet; breadth 7 feet; and the depth 2 feet $4\frac{1}{2}$ inches; the freeboard, of course, varies with the load, the draught being very little when the boat is not loaded. The boats have flat bottoms, slightly stepped close to the stern and have a rather sharp rise at the bow, effecting a broad, flat prow, similar to the seaplane type.

Each rib of these boats is made from one piece of channel iron, $1\frac{1}{2}$ inch by $^{9}/_{16}$ inch by $\frac{1}{4}$ inch, with the exception of the frame at rear end of forward bulkhead which is of $1\frac{1}{2}$ inch by $1\frac{1}{2}$ inch by $\frac{3}{8}$ inch angle iron. The two floor stringers are 3 inches by 3 inches by $\frac{3}{8}$ inch angles punched and bolted in position to each frame, prior to arc welding. Angle-iron stringers are also welded to each side of the channel frames. These stringers are also punched and bolted to the frames to maintain perfect alignment, until arc welded. Deck beams over the fore and aft bulkheads are angles, arc welded directly to top ends of frames. Clamps formed from flat plate are arc welded to every other frame to carry the deck on both sides of the open cockpit.

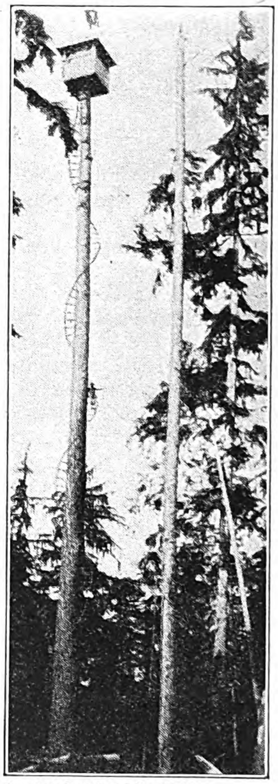
The bottom and side plates are joined to the frames by short fillet welds about $1\frac{1}{2}$ inches long and approximately 7 inches apart. The bottom is of $\frac{1}{4}$ inch plate, the sides of $^{3}/_{16}$ inch plate and the deck of No. 10 gage sheet steel. The bumpers at the bow of the boat are for pushing barges.

Each boat is to be powered by a 125-horsepower six-cylinder gasoline engine equipped with a reduction gear having a ratio of three to one. With this arrangement the boats obtain an average speed of approximately 13 miles per hour when running with a light load or no load.

The unique design and construction of these boats is a distinct tribute to the ingenuity and engineering skill of the Engineer Corps. The success of the design and construction of these arc-welded all-steel motor launches, proved after a year's operation, marks a distinct step towards a new method of building power boats which may affect the entire industry. The ability of the electric arc welding process to make a steel hull literally one piece of steel means a stronger, more durable craft free from leakage.

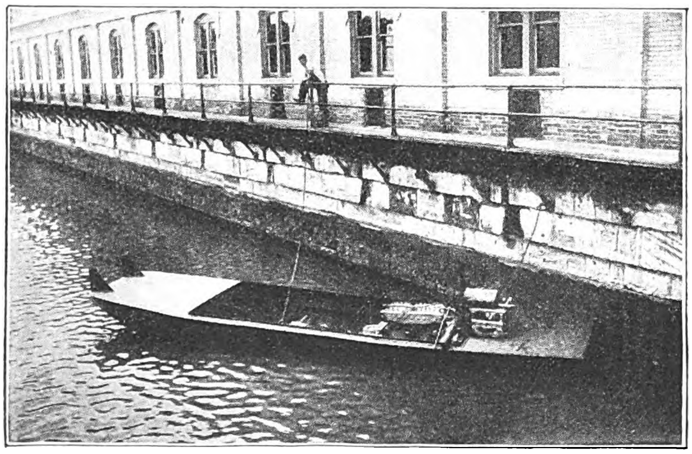
"Going Up to See In Trees"

WRITING in *American Forests and Forest Life*, Henry B. Steer recently described a look-out station for forest rangers in the Indian Forest Service that is perhaps the most unusual in the country. It consists of a roomy cage seven feet square atop a 170-foot Douglas fir on the Quinault Indian Reservation in

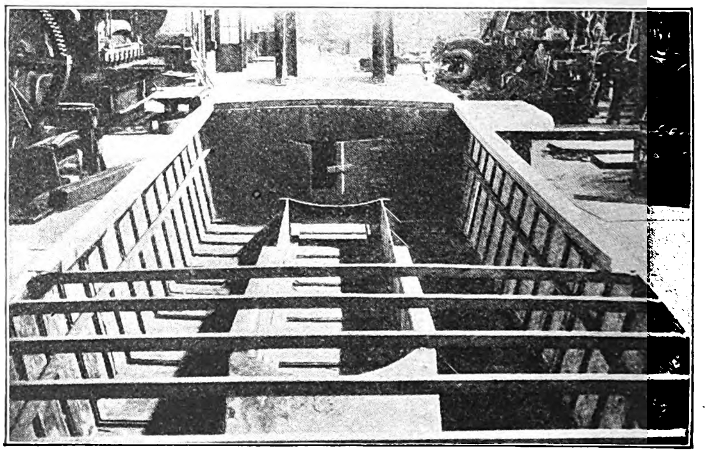


Courtesy *American Forests and Forest Life*

The spiral "stairway" that leads to the Forest Ranger's lookout station on the top of a 170-foot tree



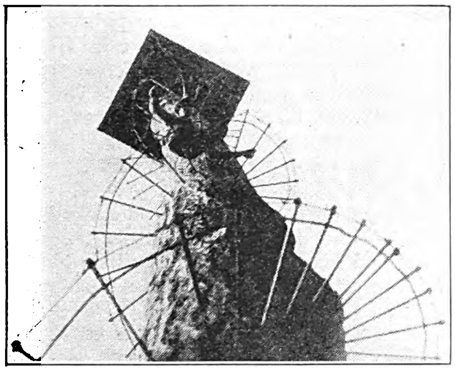
One of the arc-welded steel motor boats built by the Engineer Corps, United States Army, for river service



Interior of one of the arc-welded boats. Ribs, stringers, and beams are channels and angles; the hull is plate

Grays Harbor County, Washington. From this look-out, the ranger has an unobstructed view of timbered and cut-over lands for at least 30 miles in every direction. With high-powered binoculars, he can scan the country for the tell-tale wisps of smoke that mean forest fires.

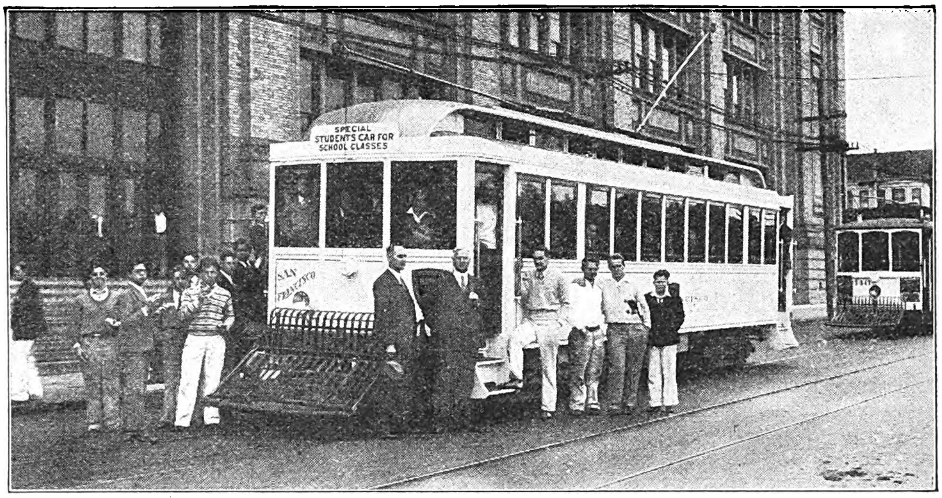
The ranger climbs to his lofty perch by means of a steel rod and rope ladder which spirals the tree trunk and enters the house through a trap door in the floor. The house is glassed in on all four sides, giving an unobstructed view in all directions. In fine weather the windows may be pushed back since they are built in frames which permit them to slide back and forth. The house has two telephones, one connecting with the headquarters camp of a large logging company operating in the vicinity of the station, and the other with the District Ranger of the United States Forest Service at Lake Quinault, for this station overlooks a portion of the Olympic National Forest as well as the major portion of the Quinault Indian Reservation. In case the look-out reports a fire, men and equipment are immediately sent to extinguish it.



Courtesy *American Forests and Forest Life*

Up the side of the tree on which the Forest Ranger's station is located, showing manner in which the step-rods were driven into the tree and the wire cable installed

The tree is securely guyed by three steel cables, for even a small house seven feet square offers considerable wind resistance when it is 170 feet from the ground. The tree is nearly seven feet through on the stump and nearly two and one half feet in diameter 170 feet from the ground at the point where the house was built. As a foundation for the house, four railroad ties were set in notches in the tree and securely bolted to the tree trunk. The house was then framed and built upon these ties.



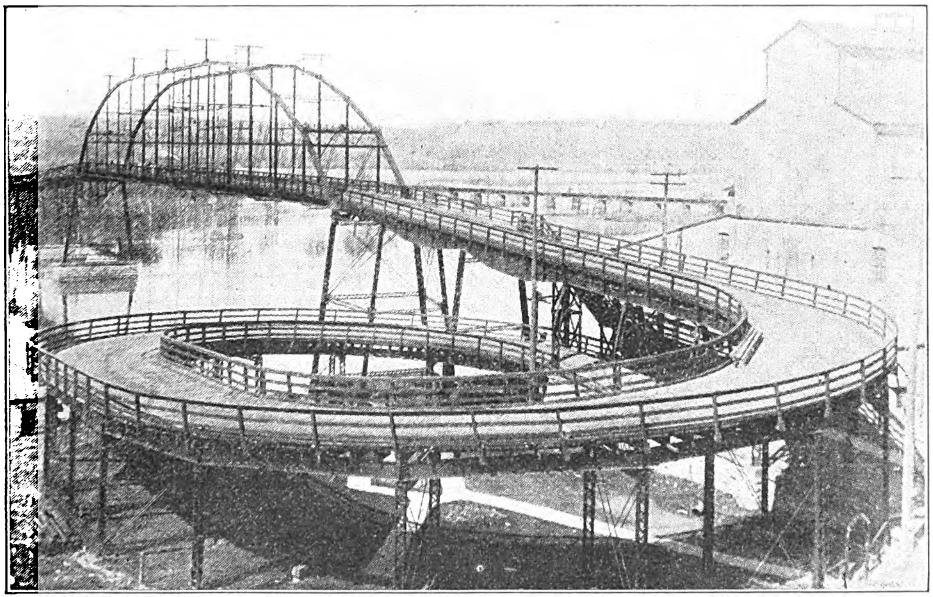
To set it apart, the San Francisco educational street car is done in white

Educational Street Car for Children and Shut-ins

AN attractive parlor street car finished in white enamel, trimmed with gold and fitted with all the latest safety appliances, is operated by the Market Street Railway Company in San Francisco for the use of children, principally for educational purposes and without charge. When schedules will permit, the car is also devoted to unprivileged and shut-in children who need to get around and who, without some such service as this, might never have the opportunity.

Thick carpet covers the floor of the center section of the parlor car, which has plush cushioned wicker chairs and heavy plush window drapes. The end sections have been fitted with the latest type of leather upholstered street-car seats.

Many trips have been made in which technical classes of the San Francisco public and parochial schools have been taken through the company's car-building plant, car operators' training room, and one of the latest sub-stations where alternating current is converted into lower-voltage direct current for use by street cars. Technically trained men explain the mechanical and electrical processes in the various departments as the classes watch the inside workings of the big machines necessary to successful street-car operation.



Courtesy *Minnesota Technolog*

Perhaps the only one of its kind in the world, this spiral approach to the bridge over the Mississippi at Hastings, Minnesota, was necessary in order to eliminate a long approach which would have run far into the business district

Light Uses Third of Electricity in Industry

POWER was generated with about two thirds of the electricity furnished to 20 industrial plants in Detroit, while lamps assisting the sun in lighting the work consumed the other third, according to H. E. Cook and T. G. Ward, electrical engineers. —*Science Service.*

Chemistry Helped "Graf Zeppelin's" Record Flight

MUCH of the romance of industry is epitomized by the recent aerial circumnavigation of the globe by the *Graf Zeppelin*. Underlying the many spectacular features of the epoch-making flight, although very much in the background, is the steady march of modern science, which has made possible the brilliant success of the project.

One of the major problems challenging the ingenuity and resourcefulness of chemists was the problem of refueling the giant ship at its various ports of call in the United States and foreign countries.

The motors of the *Graf Zeppelin* burn gaseous fuel, which is carried in balloonets in the interior of the ship, the fuel originally used being Blau gas. This is a very satisfactory fuel gas, because it is about the same weight as air and thus the lifting power of the ship is not affected as the gas is consumed. Since this gas is available in quantities only in Germany, the problem of fueling in foreign countries was put up to chemists of The Linde Air Products Company and the Carbide and Carbon Chemicals Corporation, both units of the Union Carbide and Carbon Corporation, as authorities on the manufacture and use of such gases.

Since nowadays compressed and liquefied gases of many kinds are transported in steel cylinders and tank cars, to serve various industrial needs, with the same facility as the most commonplace commodities, the problem was solved without much diffi-

(*Please turn to page* 543)

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

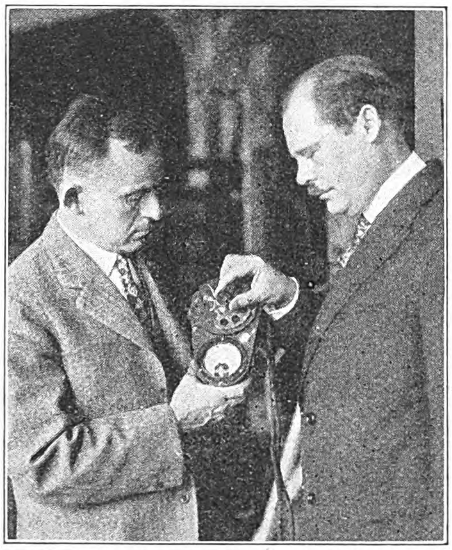
CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

A Radio Altimeter

THE ordinary altimeter really indicates air pressure only. The height is deduced from a conventional relationship between decrease of pressure and the pressure which applies on the average but not on any particular day. On a hot, low-pressure day, the altimeter may show two or three thousand feet of altitude when the plane is flying at ground level. On a cold day of high barometric pressure, the altimeter may indicate that the pilot is flying underground.

A true height indicator should not depend on atmospheric conditions, but give the real height above the ground at all times. This is particularly valuable when flying in dark or foggy weather, or when making a landing under similar conditions. There are three principles on which the height altimeter has been attempted: the acoustic method, in which the time for the reflection of a sound from the ground serves to give the height; the capacity method in which two plates on a plane serve as a condenser whose capacity is varied by approach towards the ground; and finally there is the radio method, not yet described in these columns and of real interest. Such a method is being developed by Dr. E. F. W. Alexanderson of the General Electric Company.



Dr. Alexanderson describing one of his new radio altimeter units

A radio wave travels so fast that the time of its reflection from the ground is infinitesimal and cannot be made to give a measure of the height. An indirect method, however, has given positive results.

An oscillating tube circuit is used, one of the type which sends out a wave which may be picked up on other receivers as a squealing note or beat. The echo or reflected signal is picked up on the same set as that which sends out the wave. Every time the airplane changes altitude by half a wavelength, a whistling note goes through a complete tone cycle from low pitch to high pitch and back again. By counting the cycles of the tone, using half the wavelength of the oscillator as a measuring stick, it is possible to measure the altitude. By means of the meter, graduated from 3000 to 200 feet, the pilot may read his altitude within close limits at any time. The "echoes" indicating height are periodic, becoming stronger as the plane approaches the ground. The periodic characteristics of the echo, and the chance that the pilot would not see the instrument at the instant an echo was recorded, presented a problem which was met by developing a "memory meter." In this instrument the echo is recorded as altitude when it occurs and the meter continues to hold that reading until a stronger echo, indicating a lower altitude, occurs. In approaching the earth, the memory meter gives a continuous indication of altitude.

Instruction in Fog Flying

ON returning from Europe, Major Clarence M. Young, Assistant Secretary of Commerce for Aeronautics recently stated that the Farman system of instruction in fog flying was one of the most interesting things he had noted. Our photograph shows Major Young seated in the "cockpit," so arranged that the occupant cannot see anything but his instruments. The instructor manipulates a control which causes the cockpit to sway sideways or fore-and-aft. The student, "flying blind," attempts to keep the machine on an even keel by the aid of his instruments and controls. This certainly appears to be a most practical introduction to real blind flying.

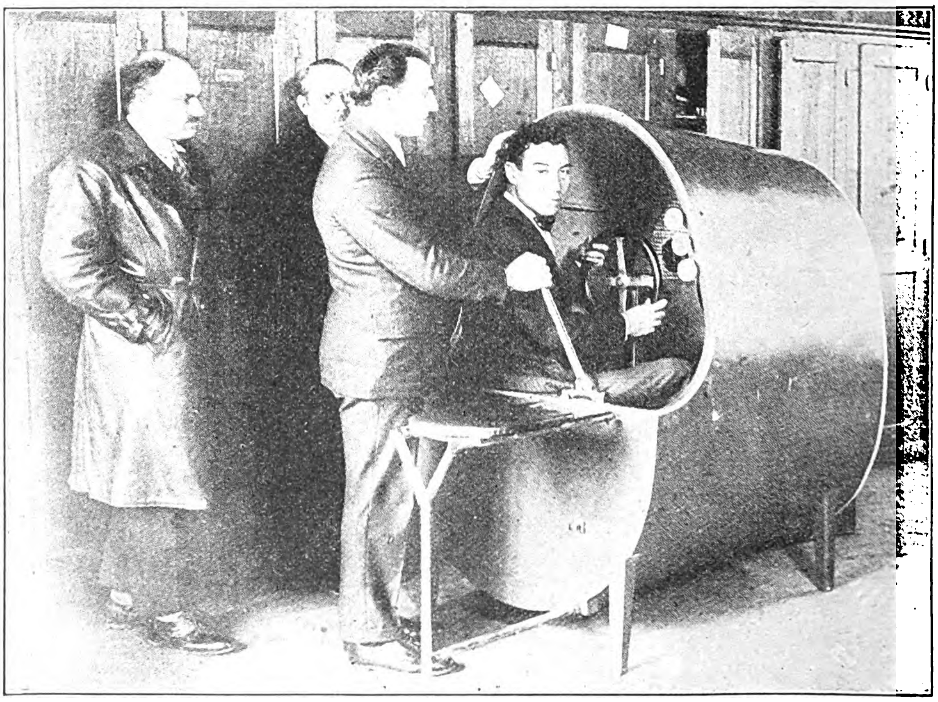
Airway Marking

OUR photograph shows the Hon. William P. MacCracken, Jr., former Assistant Secretary of Commerce, and Colonel H. H. Blee, on top of the Commerce Building in Washington examining some airway markers. A committee of the Department made an extended series of flight tests in which markings of various designs, sizes, and colors were painted on large canvases on this roof and tested under a wide variety of weather conditions. Night tests with illumination by various methods were also tried. As a result of these tests, and of a conference at Wichita, certain definite recommendations were adopted.

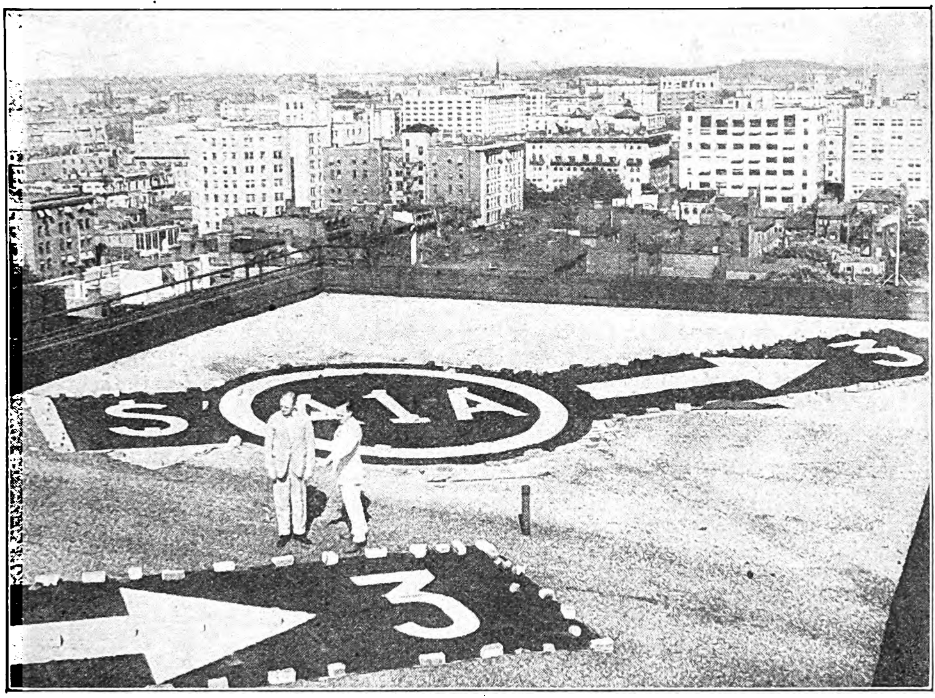
The markings should be as simple as possible, and have maximum attractive power and visibility under all atmospheric conditions. They should be effective at night.

The markings should give the pilot his position and indicate the direction and distance to the nearest landing field, as well as the general equipment and facilities available at such landing field. They should include the name of the city, and have a meridian marker.

The best results are apparently obtained by using chrome yellow characters on a darker background. The height of the lettering should be from 10 to 30 feet, and under no circumstances less than six feet. Plain vertical Gothic capital lettering is recommended.



A "cockpit" for instruction in blind flying



A typical airway marker. See page 528 and left-hand column below

The marking shown in the photograph is typical. The S preceding the pointer indicates that there are seaplane facilities ahead. Within the circle is the rating of the airport. The figure 3 indicates the distance from the airport.

There will soon arise a need for a distinctive mark or symbol to distinguish airway markings from advertising matter. It is important that air markings be placed on the most outstanding buildings or structures, selecting such locations where there is no likelihood of interference from smoke.

In marking metal, shingle, concrete, slate, tile, and similar roofs, the markings may be painted directly on the roof itself, using a good grade of chrome yellow paint of semi-mat finish. Another method is to use markings constructed of painted galvanized iron or other rust-resisting material. When necessary the roof should be treated in such a manner as to afford a dead black background. Raised markings are thought to have a definite advantage, as those placed or painted directly on the roof are very likely to become covered with dirt or soot and in the winter to be blanketed with snow.

There are three general systems of illumination:

(1) By reflected light, in which either floodlight projectors with spread lenses or industrial reflectors are so arranged as to give a uniform distribution of light of proper intensity over the entire surface of the marking.

(2) By transmitted light in which incandescent lamps are mounted under translucent glass strips of suitable color arranged to form the letters or symbols.

(3) By direct light in which the markings are outlined by exposed incandescent lamps or by neon tubes placed along the center lines of the lettering and other symbols.

Illumination by direct light is most effective owing to the greater brilliancy and greater attracting power. Certainly every city which wishes to keep in the foreground will have to give roof marking serious attention. And nothing will give aviation more practical help than such airway markings throughout the country.

Slots and Interceptors

As we have often pointed out in these pages, the great advantage of the Handley Page slot is that it prevents stalling when the angle of incidence becomes too large. The use of a front slot in conjunction with the ailerons ensures perfect control at slow speeds or high angles of incidence.

One way to use the slot and aileron control is that indicated in one of our drawings, where the aileron is connected by a link mechanism with the slot. With the aileron in its normal position, the slot is only slightly open. When the aileron is down, we want the greatest possible lift on the same side of the wing, and therefore the front slot is open to its greatest extent. When the aileron is up, we want the least possible lift on the wing ahead of the up aileron, and therefore the corresponding slot should be closed.

There is a certain complication in having the slot operated manually, and it is much better to have it open automatically, under the forward movement of the suction on top of the wing. In our second drawing such an automatic action is indicated, and at high angles of incidence the slot is always open. The difficulty involved in this arrangement is that on the side on which the aileron is down, there is not only more lift but also more drag. Hence the machine tends to turn incorrectly for a given bank. We bank to the right and the machine tends to turn to the left.

The interceptor combined with the automatic slot and aileron gives absolutely the last word in lateral control at slow speeds, and meets this difficulty. Let us imagine that we are flying at high incidence. The slot is open. The depressed aileron compresses the spring, but does nothing to the interceptor, which is a flap on the upper surface of the wing. But when the aileron is pulled up, the interceptor is opened out. Therefore, the drag is increased on the side where the lift is decreased. When the machine is banked to the right, it therefore also tends to turn to the right.

There are many methods by which it is possible to achieve the same end. The result is worth much trouble.

Selling the Light Airplane

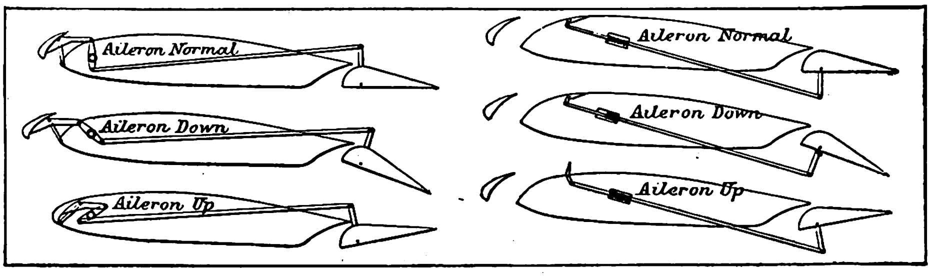
The National Air Races at Cleveland were a tremendous success in attracting the public's attention to flying, yet we doubt whether the races benefited American aviation so very much because several accidents (probably unavoidable in an event of this character) serve to give the public a wrong impression of aviation dangers. The Cleveland Air Show, on the other hand, was distinctly disappointing. The number of visitors at this show was comparatively small because so many of them preferred to spend their time at the races. Few planes were sold, and manufacturers and dealers were rather disheartened. In the last two years the aircraft industry has been financed on a generous scale by the public and its productive capacity has been enormously increased. It is doubtful whether the market for planes has kept pace with the possible output. The industry is now entering on a competitive phase and the problem of sales has become paramount.

From an article in *Aviation* by Jack W. Duelks of the American Aircraft Corporation, it would appear that our airplane distributors are fully alive to the situation and that their sales methods and plans are being improved constantly.

The distributor finds it best to announce his demonstrations to a few selected men. General announcements are apt to bring such a crowd to the airport that sales are actually hindered by excess of public interest.

The demonstration at an airport follows well defined lines. The pilot makes a quick take-off, shows the fast climb of his ship, and then flies across the field at minimum speed to show how slowly and under what perfect control he can fly when need be. After gaining altitude, a low loop and a slow roll are performed. Then come inverted flights and climbs in inverted flight, which are always very impressive. It may be asked why a prospect who will never be required to undertake such maneuvers is given a demonstration of stunt flying. The answer is that stunt flying gives an impression of the perfect command which a pilot has over his plane under all conditions and thus inspires confidence in the prospective purchaser.

(*Please turn to page* 548)



Illustrating "Slots and Interceptors" above

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Synthetic Resin Improves Lacquers

PYROXYLIN lacquers, to which we owe the lastingly beautiful finish of our automobiles, furniture, and hundreds of other common objects, are basically nitrocellulose, or gun cotton. This very useful product has one disadvantage for this purpose, however, for the film formed upon drying normally lacks luster and adhesion. This has been overcome in modern lacquer production by the addition of resins to the lacquer.

Unfortunately, the materials which are the best solvents for nitrocellulose are the poorest solvents for these resins, and vice versa. With some resins it is very difficult to get a homogeneous solution containing both nitrocellulose and resin, and practically impossible to get a homogeneous film. With any natural resin the lacquer formulator must balance his resin and lacquer solvents very skilfully, and he is constantly confronted with the difficulty that he has, as an ingredient, a material which in many respects is incompatible with nitrocellulose.

Alan C. Johnston, of the Hercules Powder Company, describes in a recent issue of *Industrial and Engineering Chemistry*, a new synthetic resin which appears to be ideally adapted for use in lacquers because it is soluble in nitrocellulose solvents. This latest contribution of synthetic chemistry to lacquer technology is ethyl abietate. Until recently this compound was regarded as a laboratory curiosity, but is now available commercially.

Commercial ethyl abietate has a very slight but agreeable odor. In lacquers the odor is not apparent. Sunlight does not discolor the material itself. When used in a lacquer containing zinc oxide and nitrocellulose, the film does not discolor any more than does a lacquer containing zinc oxide, nitrocellulose, dibutyl phthalate, and dammar gum, both films discoloring to a considerably less extent than films containing zinc oxide, nitrocellulose, dibutyl phthalate, and ester gum.

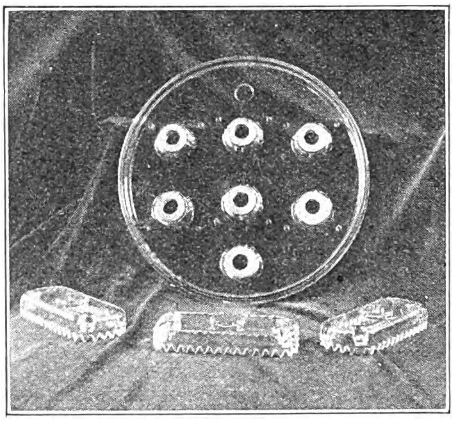
In ethyl abietate a natural resin has been changed in chemical composition in such a way that, while it still retains its primary resin characteristics and imparts to the film gloss, depth, body, and adhesion, as a resin should, it has ceased to be incompatible with nitrocellulose and has come to have actually a latent solvent action on nitrocellulose.

Powdered Fuels for Engines

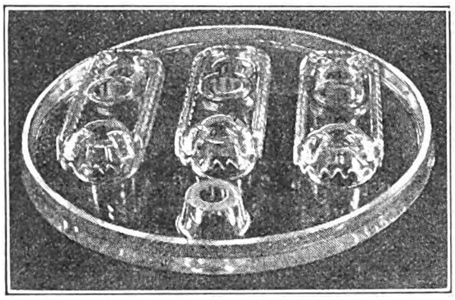
AFTER many trials and failures, a practical and reliable internal combustion engine appears to have been developed to utilize powdered coal as fuel. Unlike the Diesel engine, states Rudolph Pawlikowski in *Canadian Chemistry and Metallurgy*, it compresses air and fuel at the same time, but keeps them separated until the injection, after the compression. In the Diesel engine, fuel oil must be atomized, heated, and ignited in a small fraction of an engine stroke; the new engine allows a complete stroke for these operations. The engine has been successfully operated on dust of bituminous coal, lignite, peat, wood, charcoal, rice hulls, meal, and coke. Ash disposal, of course, is one of the major problems; but in this engine the ash is so fine that the particles, even if they do get into the oil film, rub on only one of the metal surfaces, not on both. The exhaust is said to be odorless.

Industrial Stills Made of Glass

TRADITIONAL conception of the chemist links him with test-tubes, beakers, and weird assemblies of glassware, but beyond the laboratory, in the actual chemical plant, steel and special alloys dominate the scene and glass apparatus is seldom seen. Yet the many advantages of glass in handling chemicals have long tempted the industrial chemist, and only the mechanical difficulties involved in constructing commercial apparatus have prevented his reversion to this useful laboratory material. Now, however, science has brought such advances to glass technology that the chemical engineer is able to build commercial units out of special glass. A. A. Backhaus made this significant revelation to a recent meeting of the Institute of Chemical Engineers when he described a distilling column, two feet in diameter, designed for the manufacturer of industrial alcohol, in which the intricate and cumbersome parts are all cast in glass.



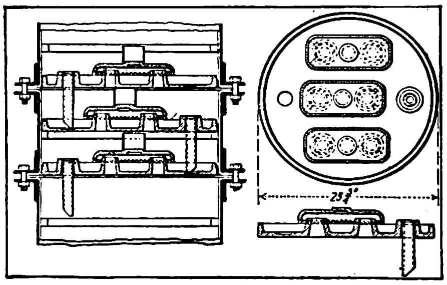
Above: **Special glass plate with its three bonnets.** *Below:* **The bonnet-type glass still plate assembled**



When this rather radical plan was first considered, the possibility of both the perforated and the bonnet type of distilling plate was considered. Within a short time samples of glass disks 13 inches in diameter, perforated by sand blast, were submitted. The cost of producing perforations in this manner was prohibitive.

Further experimentation finally resulted in a bonnet-type glass plate design which would be possible from the standpoint of glass practice and at the same time make a practical job for distillation work.

This column has been in use two years for distilling anhydrous solutions containing alcohol and hydrogen chloride. As is well known, corrosion is greatly increased when erosion occurs simultaneously. In a distilling column the plates, and especially the bonnets, are subjected to the erosion of a violently boiling liquid. Corrosive liquids under these circumstances make a column short-lived. Lead plates used for the job in question lasted only a few months, while the lead lining of the shell showed good life. The use of glass plates has here resulted in a useful combination.



Drawing of assembled distilling column in relation to a bonneted plate

Standardized "Weighting" Practice Adopted by Silk Industry

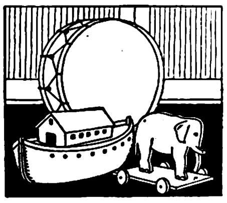
SILK weighting is an art which has its uses and, like many other good things, its dangers. Properly weighted silk has better luster, "feel," and draping qualities than pure dyed silk. The weighting material is cheaper than the fiber, and the makers have sometimes been tempted over much by the demand for cheap silk dresses. Quality has sometimes been sacrificed to price by over-weighting. The industry is striving to correct this by setting up standards of good practice, with the cooperation of the Bureau of Standards.

Silk, as the silk-worm produces it, is covered with an outer layer of soluble gum, known as serecin. This is removed by treatment in a hot alkaline bath of soap with sulfonated oils or silicate of soda. The loss in weight due to this process is about 25 percent. The restoration of this loss is accomplished by successive treatments in baths containing chloride of tin, sodium phosphate, and silicate of soda; but as a well-known textile chemist has recently said, the fiber has no judgment. It will go on taking up mineral matter until it no longer retains properties which we value in silk.

Every dyer knows that weighting "plumps" the silk fiber and improves its luster, the feel of the goods is better, and the dyer says it has a better "hand;" the

For toys at Christmas time, for industry all the time ...this *grainless* wood board

The discovery of a method to make wood grainless is revolutionizing many industrial processes, is giving manufacturers a new material with which to improve products and reduce costs. Perhaps you, too, can profitably use this grainless wood. A sample and the Presdwood booklet are yours for the asking. Both are FREE.



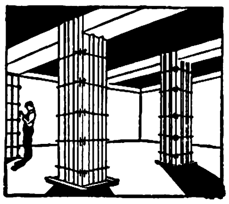
FOR CHILDREN'S CHRISTMAS TOYS

Now tiny tots can play with wooden toys that will not splinter. Motor truck bodies are made strong and smooth with a material that neither cracks nor splits. Glistening concrete walls of towering skyscrapers require practically no hand smoothing because of a perfect, smooth board that lines the forms. All these developments, and scores of others in manufacturing and building, are possible today because of the grainless wood board, Masonite Presdwood.

Manufacturers find that Presdwood has many properties which adapt it to production methods. Builders find its smooth surface, its uniform ⅛th inch thickness, and its broad four foot by twelve foot pieces ideal for paneling, display booths, closet lining, breakfast nooks, and for lining ventilator and elevator shafts.

Easily worked—in factory or home

While the grainless nature of Presdwood is perhaps its most remarkable feature, it is far from the only property which makes Presdwood popular. This grainless wood is hard, smooth, strong, and dense. It never harms fine tools; it can be punched, die cut, milled, or sanded; it is also ideal for the home mechanic who has little to work with but a hammer and saw. And when an article is completed it can be left just as it is because of Presdwood's natural beauty and resistance to moisture, or can be given any commercial finish.



FOR LINING CONCRETE FORMS

This grainless wood is used in radio cabinets, tension boards for loud speakers, beds of portable billiard tables, book cases, kitchen cabinets, show cases, and china closets. It makes strong shipping containers, weather resisting road signs, light partitions, durable work bench tops, and attractive novelties such as bedroom screens, fire screens, and trays.

Lines concrete forms

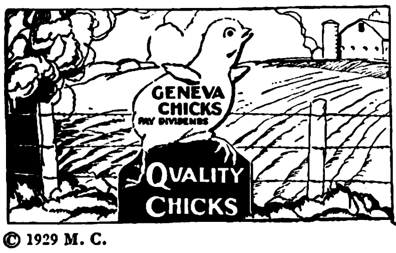
Building contractors reduce labor costs on concrete work as much as 40 per cent when Presdwood lines the forms, for the face of Presdwood leaves the concrete perfectly smooth so that the process of polishing with carborundum bricks can be entirely eliminated.

Every manufacturer, builder, and home mechanic should read the fascinating story of wood made grainless. It is the record of a scientific experiment with live steam at 1,000 pounds pressure—an experiment which revealed a way to make grainless wood commercially.

The Presdwood booklet tells this story, lists 80 uses for this grainless wood, and tells how various finishes should be applied. The booklet and a sample of Presdwood are yours for the asking. A postcard brings them.

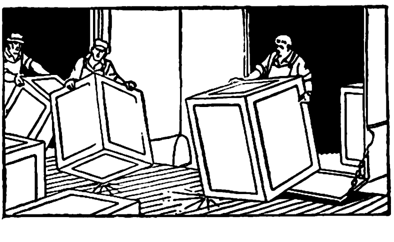
MASONITE CORPORATION
Dept. 744, 111 West Washington Street
Chicago, Illinois

FOR WEATHER RESISTING SIGNS



Masonite PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

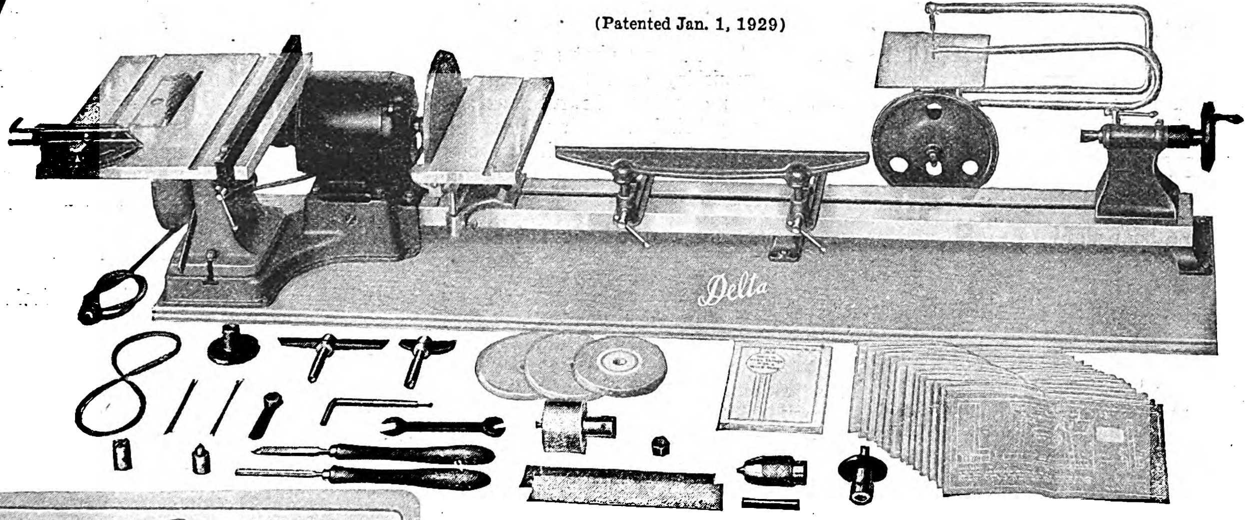
FOR STURDY SHIPPING CONTAINERS



© 1929 M. C.

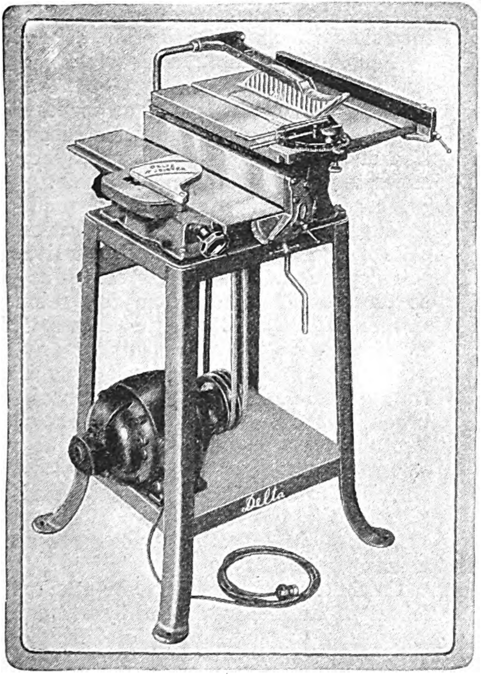
Announcing The New "1930" Models "Delta" Woodworking Units

(Patented Jan. 1, 1929)



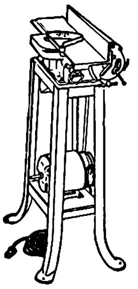
"Delta" Electric Handi-Shop

A complete Motorized Workshop for craftsmen, including all necessary equipment for Circular Sawing, Wood Turning, Scroll Sawing, Sanding, Drilling, Grinding and Buffing.



Combination 4-inch Jointer and 8-inch Circular Saw Unit

mounted conveniently on welded steel stand. Both machines can be used together or separately. Furnished with or without motor.

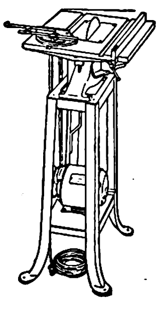


4-inch Jointer Unit

of new, practical design. Mounted on stand. Furnished with or without motor.

8-inch Circular Saw Unit

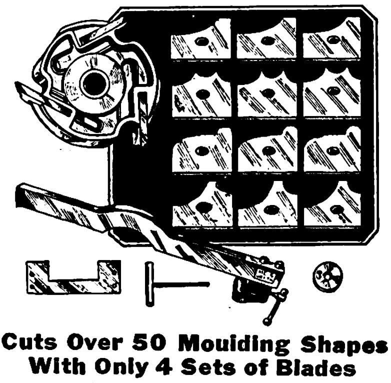
mounted separately on sturdy, welded steel stand. Furnished with or without motor.



Practical Design — Dependable Quality — *Plus* Many Exclusive Features —

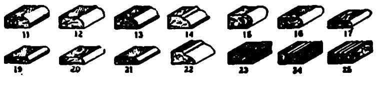
that's what you find in every woodworking unit bearing the Delta trademark. Craftsmen, artisans, farmers, mechanics—all who use wood in their daily labors or spare-time hobbies—are delighted with the sturdy construction, splendid efficiency, and moderate cost of Delta equipment. They appreciate keenly such exclusive constructional features as the Patented Tilting Tables, Automatically-oiled Bronze Bearings, Heavy U-Shaped Lathe Bed, Circular Saw Raising Lever in the Handi-Shop—the new Welded Steel Stands, Graduated Fence, Practical Rip Gauge, Graduated Miter Gauge, and the convenient arrangement, in the new Delta Jointer and Circular Saw Units, which can be used with your motor, if desired.

New "*Delta*" MOULDING CUTTER



Cuts Over 50 Moulding Shapes With Only 4 Sets of Blades

High speed blades produce over 10,000 cuts per minute at 3500 R.P.M. Blades require no individual adjustment. Quickly and easily locked in position. Special guide fence. Unusually low price.



10 Day Trial

Easy Terms

For complete details and full description of the new 1930 Delta line, send coupon for FREE illustrated literature. Shows many items of interest to those who work with wood. You will learn, also, how you can try any Delta equipment for 10 days under actual working conditions at our risk. Choice of three convenient payment plans. Mail coupon TODAY!

DELTA SPECIALTY CO.
Division of
DELTA MANUFACTURING CO,
1661-67 Holton St. Milwaukee, Wis.
DEPT. S-129

DELTA SPECIALTY COMPANY, Dept. S-129
Division of "Delta Manufacturing Co."
1661-67 Holton St., Milwaukee, Wis.

Please send me FREE, illustrated literature describing 1930 model "Delta" Woodworking Units. Also details of 10 Day Trial Offer and Easy Payment Plans.

Name...

Address...

....

Elasticity declines at lower weights than tensile strength. A fiber which showed 26 percent stretch after boiling off, but without weighting, showed 28 percent stretch when weighted 30 percent above par, 24 percent at 40, and 20 percent at 50 above par.

Quality of silk in relation to the conditions of its use requires much further study. There is good reason to expect that its resistance to abrasion or wear will be found better after proper weighting than before. This is an important factor. It has been aptly said there is no reason to suppose that a silkworm has a lady's dress in mind when performing the synthesis of his useful product. Its adaptability to human uses is an accident.

Ethanolamine Soap Has Many Uses

We see and hear a great deal about the remarkable properties of certain brands of soap in connection with youthful complexions, skins you love to touch, and so on, but the chemist has gone the advertising man one better by developing an entirely new kind of soap in which neither "fat" nor lye, the traditional raw materials of soap production, are used. This new product is known as ethanolamine soap because it is made from a fatty acid and ethanolamine. Ralf B. Trusler, an industrial fellow at the Mellon Institute of Industrial Research, describes this "synthetic" soap in the current issue of *Industrial and Engineering Chemistry*.

The ethanolamines (there are three in the family—mono-, di-, and tri-) are synthesized from ammonia. There are three possible homologous types of ethanolamine soaps, depending upon which one of the three ethanolamines is used. However, for technical purposes, a mixture of the three can be used advantageously, because they are quite similar in their properties. Any of the three ethanolamines as well as technical "ethanolamine" combines readily with fatty acids to produce soaps.

Ethanolamine soaps are pale yellow to reddish brown, depending upon the purity and color of the fatty acids employed, and, generally speaking, all these compounds have an agreeable, soapy odor. Those made from the higher fatty acids, such as oleic and steric acids, are soluble in a great variety of organic solvents, which is one of their unusual and outstanding properties. They are dissolved readily by benzine, toluene, and similar compounds. Turpentine, alcohols, glycols, glycerol, ketones, and many aldehydes are excellent solvents for these soaps. It is surprising to note that even heavy petroleum products, such as lubricating oils and petrolatum, will dissolve quite appreciable amounts. This is particularly true of the oleate. In most cases, excepting the heavy oils, the ethanolamine soaps are soluble in the solvents in all proportions, yielding transparent solutions.

Ethanolamine oleate possesses striking emulsifying ability in promoting oil-in-water emulsions.

It has been found that small amounts, in the proximity of 0.3 to 1 percent of these soaps dissolved in lubricating oils, either increase their viscosity or cause them to gel. In many instances heavy oils can be rendered non-running and given increased consistency, and appear to be suitable for pressure oiling systems (not for internal-combustion engines) and for cup and gear greases.

A convenient and efficient means for removing oil and grease from articles and clothing can be made by dissolving about 10 to 20 percent of the oleate in a convenient solvent, such as naphtha, carbon tetrachloride, ethylene dichloride, and the like. A solution such as this has been successfully used in cleaning greasy walls, woodwork, mechanisms, automobile bodies, and parts covered with grease and oil, by brushing or rubbing it over the surfaces to be cleaned. After the solvent has evaporated, the grease and oil can be often completely removed by washing with water, because the grime is removed as an emulsion as the soap is taken up by the water.

Ethanolamine oleate in the presence of moisture has a marked softening action upon starch, sugar, and other non-greasy substances, thus facilitating the cleaning of garments. In fact, much of the laborious spotting-out operation usually experienced by dry-cleaners can be avoided by using this soap in the regular dry cleaning operation. For cleaning felt and wool hats, where the soap in naphtha is applied by hand, particularly good results have been obtained.

Carbon Dioxide Gas Used to Fight Fire

Carbon dioxide, the gas which we exhale and which gives the sparkle to our soft drinks, has begun the conquest of a new realm—that of fire fighting. Because it is comparatively easy to liquefy and is safely handled in that condition, its fire-blanketing property is useful in certain conflagrations. One of the illustrations shows a fire in a large lacquer dip tank being extinguished through the use of the Alfite system, which utilizes carbon dioxide as the extinguishing agent. This photograph was taken just at the moment when all flame had disappeared and the fire was out. The fire was extinguished in seven seconds, after being allowed to burn for two minutes.

In the other illustration a lacquer fire is being extinguished by the "fireman" who is directing a blanket of carbon dioxide over the flames. This system is called "Fyre-Freez" because, in addition to the blanketing effect, some of the effectiveness of the system is attributed to the chilling effect of the carbon dioxide. Because of the high pressure under which it is stored the CO_2 falls on the fire at a temperature far below zero.

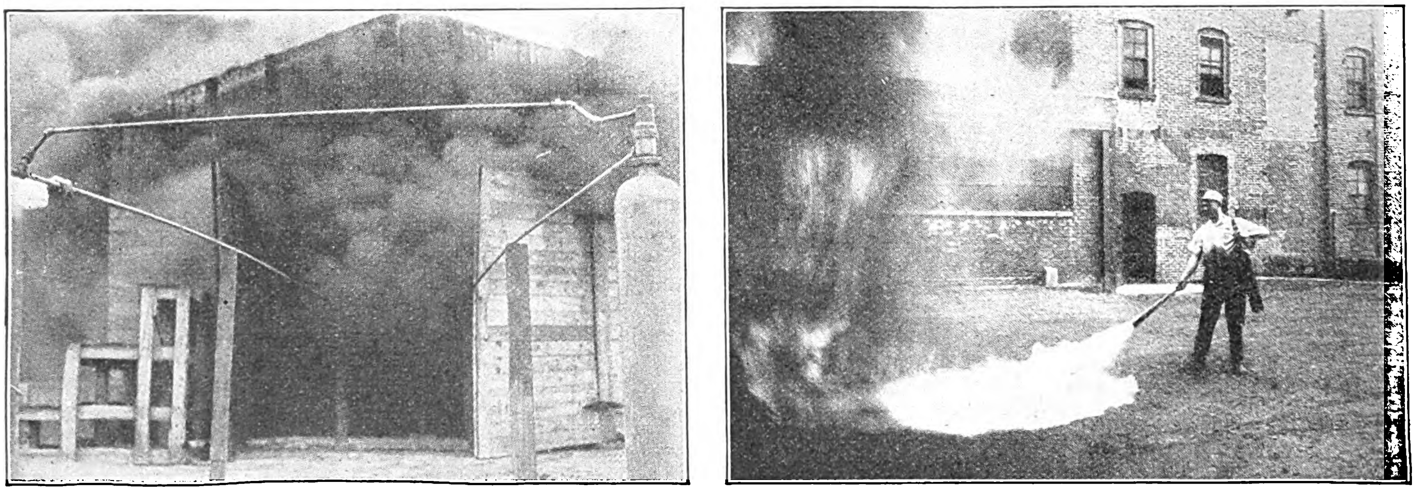
Fish Fussy About Salt in Their Water

Nearly everyone has "felt like a fish out of water" but it is only recently that scientists of the United States Bureau of Mines have looked into the question of how a fresh-water fish feels in salt water, and vice versa. Here is a typical example of the strange fields into which industrial and research chemistry leads its votaries, for this particular investigation, conducted by L. Schmidt and J. M. Devine, had for its objective the discovery of how the wastes from oil fields can be disposed of harmlessly. This led them to the consideration of the effect of soluble chlorides, run as waste into streams, upon the fish.

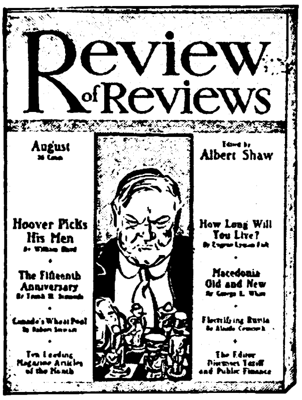
No general statement can be made regarding the maximum concentration of salts in which fresh-water fish can live, for this depends on the species of fish as well as on other factors. The top minnow, Gambusia, may be plunged directly from fresh water to sea water without any apparent ill effects. Again, such typically fresh-water fishes as the black bass, the brook trout, and the carp, are known to live and thrive well in brackish and even salt water under natural conditions where the fish is free to choose its own environment. On the other hand, salt-water fishes may be killed by a too-great saline concentration.

Calcium chloride seems to be much more lethal in its effect than sodium chloride. According to the Bureau of Fisheries, a 1 percent solution of calcium chloride

(*Please turn to page* 545)



Fire in a large lacquer tank, which fills the building shown at the left, photographed just as the flame was extinguished. At the right, carbon dioxide at a temperature several degrees below zero blanketing a lacquer fire



The Review of Reviews

Is the Leading News Magazine of Today

It Brings You Reading That's a Real Mental Eye-Opener

It's a Crystallizer of View Point—It Gives You the Assurance to Express an Opinion

6 REASONS

Why you'll like the Review of Reviews

1 BECAUSE — It brings you all the worth while news, both here and abroad. Once a month the *Review of Reviews* gives you the true, sifted substance of all that's going on in the world. A clarifying account, impartially told, of national affairs, political trends, social problems, foreign affairs and trade relations, activities in the world of business and finance — "like a monthly chat with an old friend who knows all about everything."

2 BECAUSE — It gives you more than the news. It gives an interpretation of the news. Once a month the *Review of Reviews* clarifies the disconnected, confusing news story you get through your daily reading. It interprets the news in practical terms. It makes you see our busy world in one complete picture.

3 BECAUSE — Each issue contains Dr. Shaw's intensely interesting editorials on subjects of national importance. Each month an article by Frank H. Simonds, the well known authority on European affairs.

4 BECAUSE — It's a digest of other magazines. You can't read them all. Anything that is published in periodicals or books that is too good to miss will be passed on to you in brief in the *Review of Reviews*. It's a time-saver for busy men and women who wish to keep up with the times.

5 BECAUSE — It acquaints you with the outstanding personalities of the day and has departments to cover every field of activity, *Finance, Art, Travel, Science, Books, Religion, and Sport.*

6 BECAUSE — It is the most inexpensive way to carry on a continuous education and no one can afford to stop educating himself.

"AN INTELLIGENT UNDERSTANDING" — Your interpretations of events constitute a unique contribution toward an intelligent understanding of history in the making. — **Charles M. Schwab,** *Chairman of the Board, Bethlehem Steel Corporation*

"INTIMATELY AND GRACEFULLY AND UNDERSTANDINGLY" — I have read the *Review of Reviews* in its new form from cover to cover. It is a wonder to me — always — to observe how intimately and gracefully and understandingly you present the outstanding characters and affairs of the wide world from month to month. — **Irving Bacheller,** *Author.*

"WELL-BALANCED, HIGH-MINDED" — I have been long accustomed to looking forward every month to the well-balanced, high-minded, and forward-looking comments which you have fortunately been able to make year after year for several decades. — **Edwin R. Seligman,** *Department of Political Science, Columbia University.*

ALWAYS HELPFUL — I never turn to it without obtaining both light and leading. — **John W. Davis,** *Democratic Nominee for President, 1924.*

"A SOURCE OF PROFIT AND PLEASURE" — For many years the *Review of Reviews* has been a source of profit and pleasure to me and I would like you to know that, as one of its long time readers, I feel grateful for its change in form. It is as easy to handle as before, and a joy to read. — **Col. Edward M. House,** *Author and Diplomat.*

"ONE OF OUR INDISPENSABLE MAGAZINES" — The *Review of Reviews* has always been one of our indispensable magazines ever since it was founded. You are to be congratulated in making it more indispensable — if that is possible. — **Charles A. Beard,** *Author.*

THIS COUPON
will bring you a six months' trial subscription for
$1

Review of Reviews Corporation
55 Fifth Ave.
New York City

I enclose $1.00 for a special Six Months' Trial Subscription to the Review of Reviews.

Name. ....

Address. ....

....

SA 12-29

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Liver and Iron in Anemia

YEARS ago when girls lived largely an indoor life, there was a great frequency of a disease called chlorosis, or the "green sickness." As costumes have changed to permit more freedom of motion and as women have come to take up outdoor sports, this disease has practically disappeared and is rarely seen by a modern physician. The chief symptom of chlorosis is the deficiency of red blood cells and of the red coloring matter in the blood, producing a condition called secondary anemia. It used to be the custom to treat secondary anemia by giving iron, which has the value of stimulating the formation of the red coloring matter; small doses of arsenic were used with the idea that they aided the bone marrow in producing red blood cells.

A few years ago investigators in the laboratory of the University of Rochester, New York, found that animals could be caused to have some new blood very promptly after they had been submitted to hemorrhages, by feeding them with meats. Of all the meat substances available, liver and kidney seemed to be superior. It was generally thought that this action was due to the fact that these tissues are rich in iron. On the basis of this work, however, Boston investigators proved that extracts of liver had some special function in stimulating the formation of blood and in preventing the destruction of red blood cells in the body. As a result of their work, pernicious anemia, formerly an incurable disease, has been brought under control.

It was thought at first that the feeding of liver would be equally satisfactory for controlling the secondary anemias, but liver seems to have failed somewhat in this regard when used either in the form of raw liver or in liver extract. Recently, Drs. Chester S. Keefer and C. S. Yang of the Peking Union Medical College in China studied the question of secondary anemia to find out whether liver alone or iron alone would be as effective as both used together in cases of secondary anemia. They tested their methods on persons recovering after blood transfusions, after surgical operations and hemorrhages, and after hookworm disease. In hookworm disease there is an anemia which apparently is due to the fact that the person with hookworm seldom eats enough of anything and certainly not enough of the vital nutritive substances.

The investigators found that iron was effective in bringing about increased regeneration of the red coloring matter in the blood in patients with secondary anemia. When liver and iron were given in combination, the increase was more rapid than when either was given alone. The results were particularly noticeable in the cases of persons with hookworm infestation.

Eye Examinations of Children

PRACTICALLY every modern school now arranges for regular examinations of the eyes of children to make sure that the child is not backward in its work because it does not see the blackboard or the books. In many schools the system has been so thoroughly worked out that it is a relatively simple matter to test a great number of children.

Investigations by the National Society for the Prevention of Blindness have shown that there were from six to twelve percent of children in schools who have defective eyes. Doctor Frank H. Rodin is convinced that such examinations should be made by the regular medical officers of the schools and that they can be assisted in the routine by the school nurse and the teachers.

In the routine examinations, children are examined in groups of ten. First the doctor looks over the eyes to make sure that there are no visible diseases. For small children, the Snellen chart with the letter E is commonly used. The child is asked to read the second line, known as the 20-20 line because normal vision demands the ability to read this line at a distance of 20 feet. If the child cannot read this line, it is then asked to read the top line and then the smaller ones.

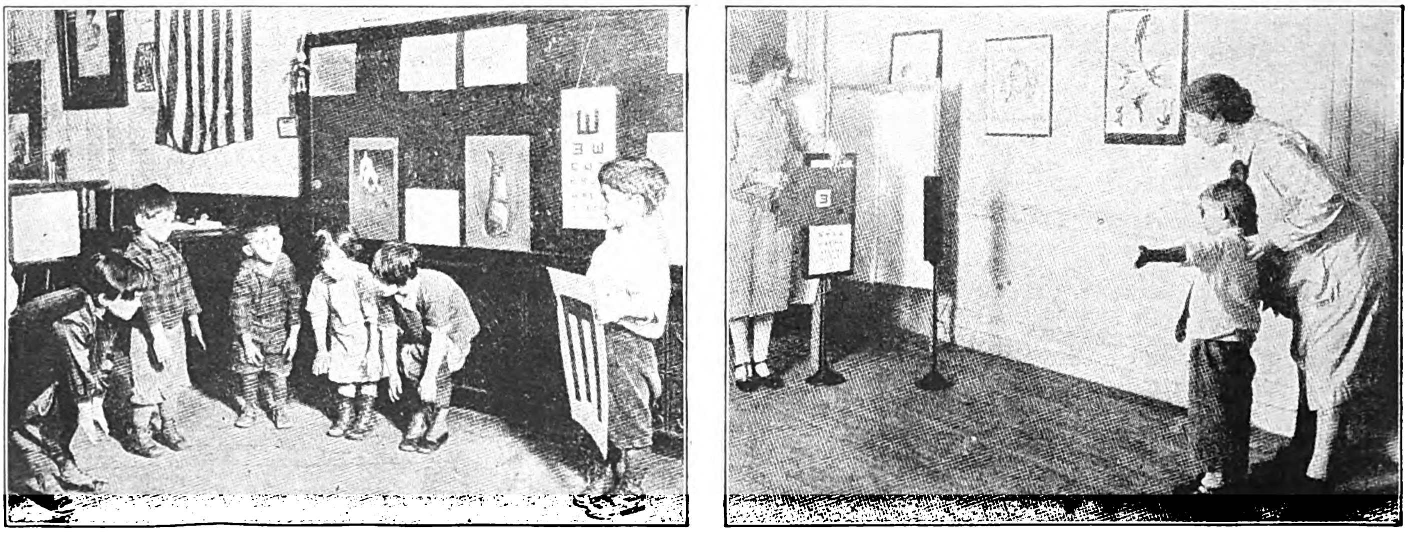
In most instances when defective vision is found, the child is referred to a specialist in diseases of the eye, in order that it may be properly treated.

Ringworm of the Feet

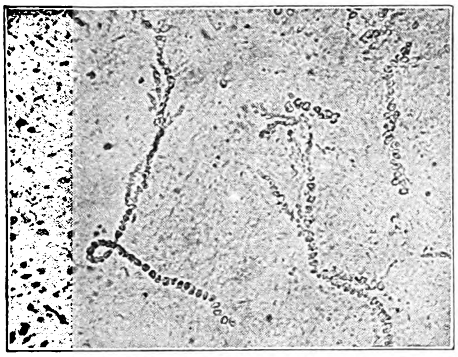
MORE and more as the gymnasium, the swimming pool and the golf club have spread throughout the land, infections of the feet have become prevalent. The most widespread of infections is the ringworm [See also page 442, November 1929 SCIENTIFIC AMERICAN.—Editor] which causes breaking down of the skin, particularly between the toes, itching, and in some cases such destruction of the tissue as to produce pain and secondary infection.

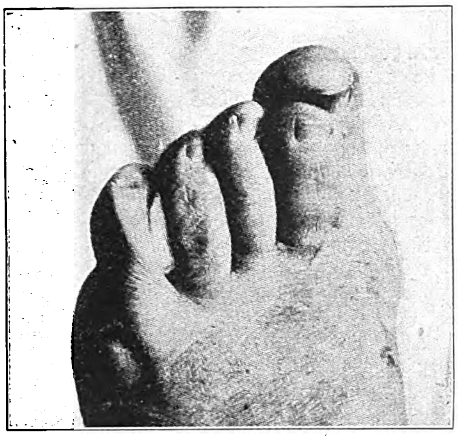
Among the measures used to overcome such infection are scrubbing of floors with antiseptic substances, insistence on the use of individual slippers or paper slippers by all who use the showers, and the application of measures directly to the infection. Unfortunately, it is quite easy for people with ringworm of the feet to become reinfected from their own clothing, unless it is thoroughly washed when it is removed.

Recently, Drs. C. M. Williams and E. A. Barthel have shown that it is possible to believe that one has recovered from the condition and then to become re-infected from very small foci of infestation from around the toe-nails. Indeed, they found by examination of clippings of the nails and of the feet of many people who were infected, that almost every one of them still had some remnants of infection about the nails. When the scrapings are examined under the microscope after being suitably prepared, the organism that causes the trouble can easily be seen. Obviously it is



Proper eye examination should be a regular part of school work





Above: The organism that causes ringworm of the feet. *Below:* Typical infection of the fifth toe-nail and thickening of the cuticle of the third nail in a case of ringworm of the feet

important to be sure that every possible foci of infestation have been removed before the individual can consider himself cured.

Nervous Baldness

It has long been known that severe worry or strain is sometimes accompanied by a sudden falling of patches of hair from the head. One of the most interesting cases of this type has recently been reported by Dr. R. B. Rogers of Neenah, Wisconsin. In the case mentioned, the father of three children had suddenly lost great patches of hair after the birth of each child in the family. Thus he had his first attack in 1915, his second in 1920 and his third in 1928.

Garage Deaths

The United States is not the only country which is greatly concerned with the number of deaths that take place from automobile exhaust gas or from other chemical hazards in the motor industry. In Germany special attention has been given to this subject in recent years. Dr. O. Marienfeld finds that there were 242 deaths in garages in Prussia during 1926, most of them from carbon monoxide gas, but some of them from benzene or benzol poisoning and a few from electrocution while working on cars with electric wires.

With the usual German thoroughness, the author prepares an outline for the investigation of safety of working conditions in garages. The outline calls for inspection of the windows as to whether they are open or closed, ventilation, gas heating, electric wiring, temperature, the place where the body is found in relationship to the car, odors, smokiness of the atmosphere, and many similar factors.

FAST'S
Self-Aligning
COUPLING

Eliminate Your Coupling Shutdowns!

EVERY TIME an old-type flexible coupling fails—trace it and almost invariably it is due to the breaking down of flexible bushings, pins, springs, discs or grids.

No wonder "fatigue of materials" so frequently sets in wherever any material is under constant bending back and forth with each revolution of the shaft. Failure comes, and the drive must be shut down to replace the broken parts.

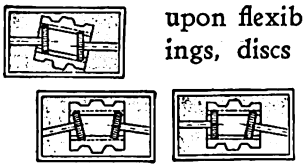
It Is Not Necessary!

Do you realize that 99% of flexible coupling troubles vanish when you replace flexible materials with the modern FAST'S Self-Aligning Coupling, which provides purely *mechanical* compensation for shaft misalignment?

See the sketch below. A spur gear on each shaft end. A casing, with internal gear teeth to match, slipped over the two gears. As one shaft turns, the casing turns also. The other shaft turns as a unit with it, the entire misalignment being taken up between the lubricated faces of the gear teeth.

Simple and Effective

Simple, isn't it? Instead of relying upon flexible pins, bushings, discs or springs to absorb misalignment, no flexible materials are used. There is nothing to fatigue, nothing to be replaced, nothing that may cause a plant shutdown for repairs when you can least afford it.



Like most inventions that have revolutionized time-honored practice, Fast's coupling is so simple that in the ten years since its first development, it has swept the coupling field because of its remarkable performance.

Read Why

If you will mail the coupon, we will send you a bound reprint of the Prof. Moore article, "What Happens in Couplings," that tells the entire story. Learn how flexible materials can be eliminated, so your plant may eliminate flexible coupling failures.

GET FREE BOOK

Sign and mail this coupon today to

The BARTLETT HAYWARD CO.
204 Scott Street
BALTIMORE, MARYLAND

Please send me the free book by Prof. Moore.

Name.................................

Firm.................................

Address..............................

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aeronautics

The Prediction of Airfoil Characteristics, Report No. 312, describes and develops methods by which the aerodynamic characteristics of an airfoil may be calculated with sufficient accuracy for use in airplane design. George J. Higgins is the author of the report. *National Advisory Committee for Aeronautics, Navy Building, Washington, D. C.—10 cents.*

Suggested City or County Aeronautics Ordinance and Uniform Field Rules for Airports, prepared by the Aeronautics Branch of the Department of Commerce, outlines a standard code of airport field rules, supplementing existing Federal regulations for aircraft in flight, designed to save aviation from the confusing traffic codes now encountered in the automobile field. *Department of Commerce, Washington, D. C.—25 cents.*

Agriculture

Industrial and Agricultural Uses of Jerusalem Artichoke is an assemblage of the available facts about a tuberous artichoke from which laevulose sugar can be extracted commercially. Suited for widespread cultivation in Canada and the United States, this tuber may become an important factor in the sugar beet industry, according to the Canadian investigators. *National Resources Intelligence Service, Department of the Interior, Ottawa, Canada—Gratis.*

Electric Stimulation of Plant Growth, by G. N. Collins, L. H. Flint, and J. W. McLane of the Bureau of Plant Industry in the Department of Agriculture, is the report of carefully conducted experiments which resulted in the conclusion that no significant change in the rate of growth can be attributed to electricity. The pamphlet is a reprint from *Journal of Agricultural Research*, Vol. 38, No. 11. *Government Printing Office, Washington, D. C.—25 cents.*

Industry

Popular Research Narratives, Third Series, is the title of a volume containing 50 short stories of what science and research is accomplishing or has accomplished. The narratives are written in plain language, on an amazing variety of topics, each planned to acquaint the reader with the outstanding developments in a specialized field. *Williams and Wilkins Company, Publishers, Baltimore, Maryland.—One Dollar.*

Diesel Power Plants for Large City Buildings, by Edgar J. Kates, is a reprint of an address given recently before the American Society of Mechanical Engineers in New York, which later appeared in *Oil Engine Power*. The paper is an analysis of the electric power requirements of large buildings, and a study of how they may be met by Diesel power plants, with figures on the economics of Diesel power in a municipal power plant, a large factory, and a typical New York office building. *American Society of Mechanical Engineers, 29 West 39th Street, New York.—Gratis.*

Explosives Service Bulletins of the Du Pont company are issued frequently to assist users of explosives in various industrial applications. "A Few Suggestions for Producing Lump Coal," and "Placing the Detonator to Get the Best Results," are titles of two of the recent bulletins. *E. I. Du Pont de Nemours & Company, Wilmington, Delaware—Gratis.*

Pertinent Questions and Answers (Bulletin No. 26) is a booklet containing much valuable information regarding respiratory protective equipment used by rescue crews and others engaged in activities requiring oxygen breathing apparatus and rescue equipment. *Mine Safety Appliances Company, Pittsburgh, Pennsylvania—Gratis.*

Dust Explosion Hazards Encountered by Firemen in Fighting Fires in Industrial Plants, by David J. Price of the United States Department of Agriculture, is an interesting and helpful presentation of information concerning an important industrial problem. *Northwest Fire School, University of Minnesota, Minneapolis, Minnesota.—Gratis.*

An X-Ray Study of Firebrick, by Albert E. R. Westman, (Bulletin No. 193) is the report of an investigation to obtain powder diffraction patterns of a number of brands of commercial firebricks, to find what information could be obtained by X-ray examinations. *Engineering Experiment Station, University of Illinois, Urbana, Illinois—15 cents.*

British Trade in Rubber and Rubber Products, by Robert B. Bacattee, the American Consul at London, has been released as Trade Information Bulletin No. 644. The study covers recent developments in the British rubber industry, with a discussion of manufacturing trends in England. *United States Government Printing Office, Washington, D. C.—10 cents.*

Oxwelding Aluminum and its Alloys describes in detail oxy-acetylene welding processes as applied to aluminum in all its forms. It includes complete instructions for welding both cast and sheet aluminum, and also the various aluminum alloys which have lately become of great importance in manufacturing processes. *Linde Air Products Company, 30 East 42nd Street, New York City—Gratis.*

Nickel Cast Iron: Theory and Practice is a well-planned portrayal of the various attributes of this alloy. *International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

Nickel Alloy Steel Products is a buyer's guide, listing manufacturers of various items under such headings as "Axles, Auto" and "Forgings." The scope of the guide is limited to those items most frequently requested of manufacturers using nickel alloys. *The International Nickel Company, Incorporated, 67 Wall Street, New York City—Gratis.*

Minerals

Mineral Resources of the United States in 1928, by Frank J. Katz and Martha B. Clark of the Bureau of Mines, is a preliminary summary of the quantity and value of all mineral products of the country for the period covered. The arrangement is alphabetical by minerals, supplemented by tables giving the mineral production by states. Imports and exports are included in the summary, with figures from the records of the Bureau of Foreign and Domestic Commerce. *United States Government Printing Office, Washington, D. C.—20 cents.*

Copper in 1927, by C. E. Jilihn and Helena M. Meyer of the Bureau of Mines, contains complete data on copper production in the United States and Alaska during the calendar year 1927. The statistics cover also the imports and exports, by-products, consumption, and uses of copper during the period. *United States Government Printing Office, Washington, D. C.—10 cents.*

Railroads

The Railroads Enter Aviation, by General W. W. Atterbury and Myron M. Stearns, is a reprint from the *Saturday Evening Post*. It is a candid portrayal of the reasoning of executives who have learned that the key to industrial and commercial development is in co-operating with new forces, rather than in opposing or seeking to ignore them. *Publicity Bureau, Pennsylvania Railroad, Broad Street Station, Philadelphia.—Gratis.*

103 Years of Railroading is the story of the New York Central Lines, and is an interesting chapter in the commercial and industrial history of the United States. *Department of Publicity, New York Central Lines, New York Central Building, New York City.—Gratis.*

Miscellaneous

PIGOTT'S BULLETIN FOR EXPORT AND INTERCOASTAL SHIPPERS is a weekly index of advance sailings for all steamship lines operating from the United States and Canada to all foreign and intercoastal ports. It is considered the standard authority for such information, and as a guide for shippers, travelers, and operators. *Pigott's Publications, Inc., 80 Broad Street, New York City.—Sample on application.*

USE OF FILMS IN THE SCHOOLS, by Dr. Gustave Straubenmuller, is an analysis of the Eastman experiment with classroom films. Dr. Straubenmuller's study was made for the Board of Superintendents of the New York Board of Education, to appraise the value of classroom films in public schools. *Eastman Teaching Films, Inc., 343 State Street, Rochester, New York.—Gratis.*

REPORT ON PROGRESS IN MANCHURIA; 1907-1928 is a well-indexed 238-page volume covering the development and exploitation of a rich region that has been the scene of many conflicts and will probably be the scene of many more. *The South Manchuria Railway, Dairen, China.—Gratis.*

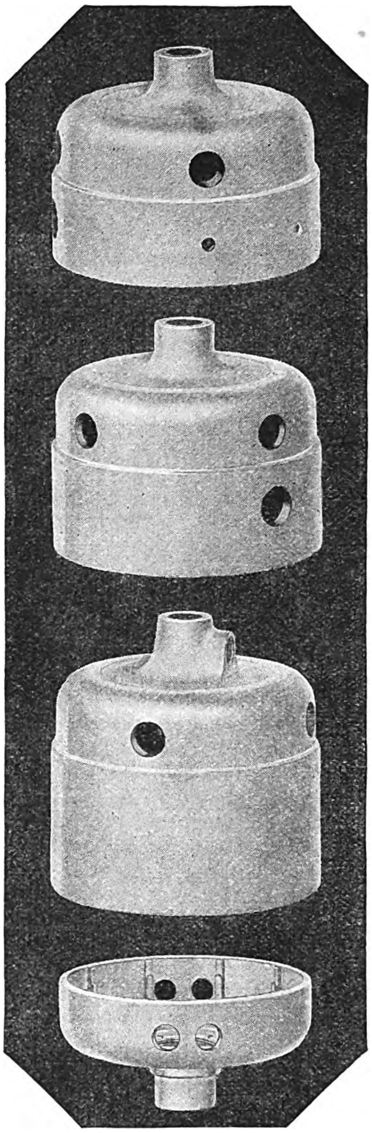
THE SPEAKER makes its debut as a monthly publication under the flag of Liberia. The initial number contains a treatise on the cultivation of the cacao tree, in addition to a number of brief essays and editorials. *D. B. Cooper, Editor, The Speaker, Cape Palmas, Liberia, West Africa.—Six cents a copy.*

STUDY OF THE OIL BURNER AS APPLIED TO DOMESTIC HEATING, TECHNICAL BULLETIN 109-T, presents comparative technical data derived from a series of tests with several types of burners to gage their performance, cost of operation, and adaptability for use in existing heating plants. It presents also a brief discussion of the relative costs of heating with oil and with gas. THE DOMESTIC OIL BURNER, DEPARTMENT CIRCULAR 405-C gives reliable non-technical information of interest to prospective purchasers. *Office of Information, Department of Agriculture, Washington, D. C.—Both gratis.*

REGULATIONS GOVERNING INTERNATIONAL CABLE AND RADIO MESSAGES, which became effective on October 1, are summarized for the benefit of code users. This summary, for the most part, is devoted to the types of languages which may be used, with specific regulations for the use of plain, code, and cipher languages. *The Merchants' Association of New York, Woolworth Building, New York City—10 cents.*

REFORMATION OF INTERFERENCE ISSUES, by Howard S. Miller, is a well-indexed booklet of 107 pages designed to help inventors and patent attorneys in prosecuting an application for patent when involved in interference proceedings. Particular attention is given to authoritative practice on setting for hearing motions under Rules 109 and 122. *Howard S. Miller, 1335 15th Street, N. W., Washington, D. C.—75 cents.*

3 Sizes of Motor Housings *from a* Single Die

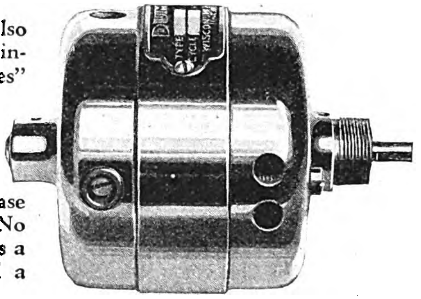


THE skill and ingenuity of Milwaukee Die Casting technicians in the design and production of interchangeable dies enables the Dumore Company to secure die cast motor housings in three different lengths with but a single die cost.

As a result, they are able to produce fractional H. P. motors of different capacities with minimum labor and expense. Each of these housings is identical in diameter and in interior and exterior contour. The different housing lengths accommodate the different lengths of "fields" which produce the various fractional H. P. capacities.

Cover Also Cast In An Interchangeable Die

The finish is an important factor in the appearance of Dumore Motors. These castings take a beautiful high lustre finish in both nickel and chrome.



The die-cast cover for the motor housings is also made in an interchangeable die to permit the incorporation of several types of "bearing bosses" for different types of motors. Some have oil holes; others have machine threads. As in the casing proper, all holes are cast in, as are the field bore and bearing seats.

The "snap fit" necessary between cover and case is achieved entirely in the casting operation. No subsequent machining is required. The joint is a lap joint with a key cast in the cover and a keyway in the case.

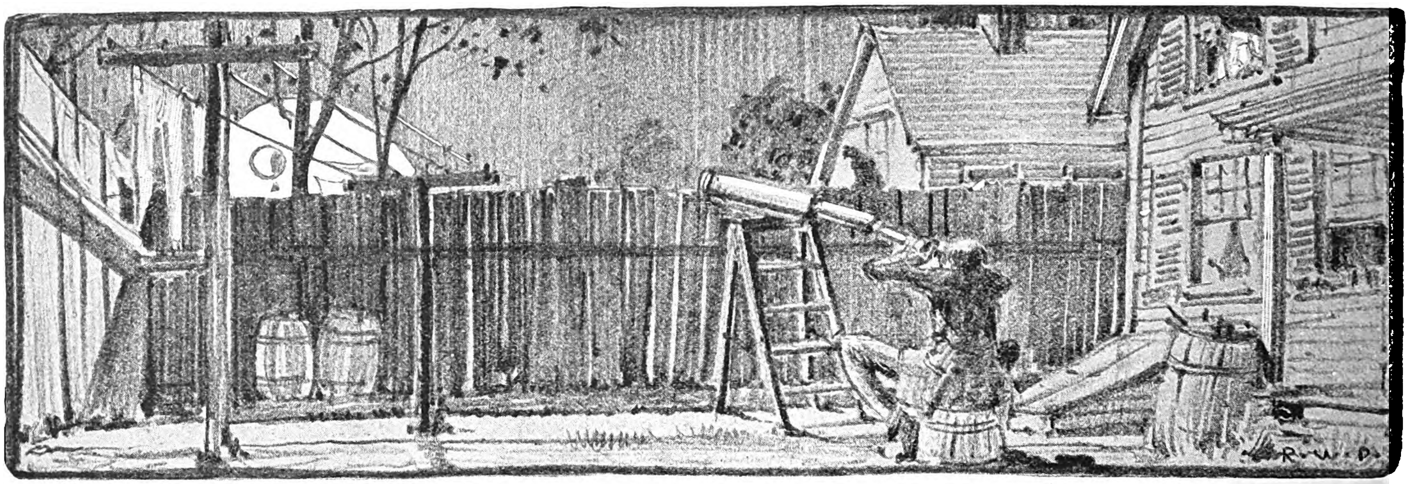
Modern developments in die casting practice may be the means of solving one of your difficult production problems. The counsel of Milwaukee Die Casting Engineers is available to you at no cost.

YOUR PRODUCT and DIE CASTING

This simply written, well illustrated booklet will reveal to you the many possibilities of die casting parts of your product. Send for your copy today.

MILWAUKEE DIE CASTING CO.
287 Fourth Street Milwaukee, Wis.

MILWAUKEE
DIE CASTINGS AND BEARINGS



The Amateur Astronomer

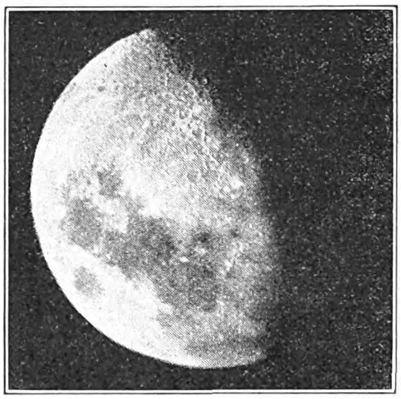
THIS month we shall cut short the telescopes, satisfying our interest by a group of pictures which have self-explanatory legends. We shall then pass on to a most informative discussion of the principles of what the astronomer calls "good seeing."

In a recent number we published a letter from Ellison, co-author of "Amateur Telescope Making," in which the following statement was made: "The real difficulty about 16- and 21-inch jobs is in the mounting and using. I know from my experience with an 18 inch that observing with a 21 inch is no picnic."

The Reverend Mr. Ellison is, of course, referring to his own seeing conditions in the climate of Northern Ireland, and these conditions will differ from those in some parts of America, particularly in the west. Nevertheless, some of the considerations having to do with seeing and its principles, touched on below, are likely to prove of value. They may explain why it is all but futile in certain parts of our country to attempt to "manufacture" better seeing than can be had, simply by using large mirrors and crowding on higher magnification; also why it is that experienced observers keep pointing out that the practicability of larger sizes than ten inch, except for photographic work, is illusory in many cases.

Discussion by Mr. A. A. C. Elliot Merlin, under the heading "Fifty Years at the Telescope," in *English and Amateur Mechanics* (London) May 24 and June 7, 1929, quoted by kind permission of the publisher, bears directly on this point.

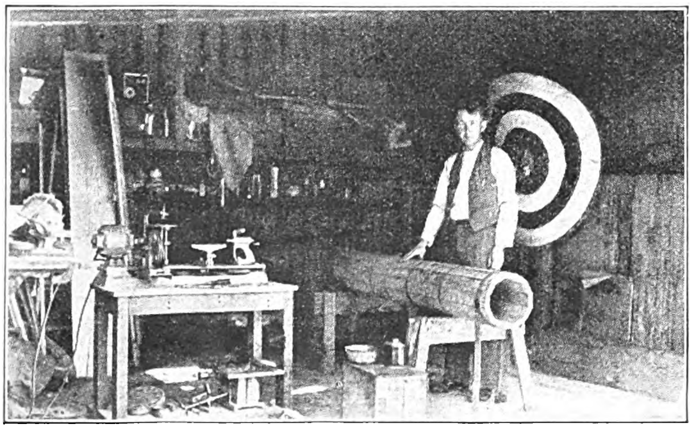
"A small instrument or five- or six-inch aperture is far more likely to reveal quickly its latent good qualities than one of eight or nine inches, for the reason that our earth's atmosphere is more frequently in a sufficiently tranquil state to allow the smaller apertures to attain their full defining limits on what must be classed as nights of exceptionally good seeing in this country. This is the secret of the popularity that the five-inch or six-inch refractor has long enjoyed. Telescopes of that size are large enough to afford sufficient light grasp when used with magnifications of 200 to 300 diameters, or even more, and at the same time encounter no excessive air hindrance, thus enabling them frequently to furnish sharp stellar images, whose spurious disks of 0.91″ for a five inch and 0.76″ for a six inch, will appear cleanly and steadily imaged on any tolerably favorable night; one which would quickly reveal its shortcomings with an instrument of perhaps only slightly larger aperture.



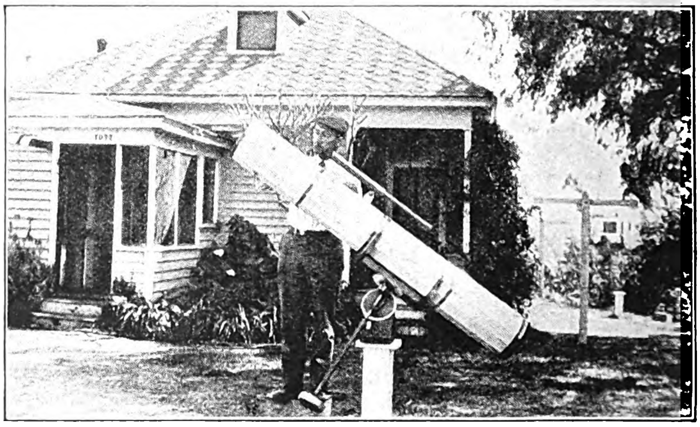
Photographed by Harold A. Lower, with an 8½ inch telescope. See "A. T. M.", p. 259

"The lack of appreciation of the most telling fact that air hindrance must necessarily increase as the square of the aperture, or ignorance of it, has led to misapprehension, chiefly directed against reflectors, for the reason that they have been, as a rule, of much larger aperture than the refractors with which their performance has been compared. The swamping of the defining quality of, say, an 18-inch aperture by what, to it, is a tempestuous atmospheric sea, is conspicuously observable; while an eight-inch aperture, reflector or refractor, placed alongside the big telescope, may be found to do sufficiently well in what is, to it, a moderate atmospheric disturbance.

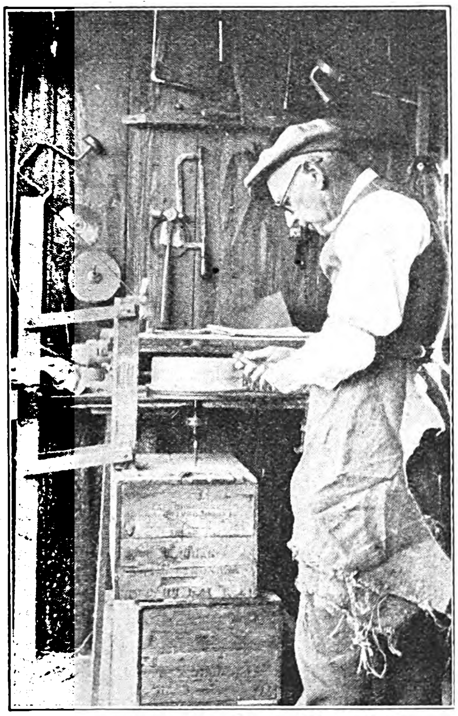
"The obvious cause," Mr. Merlin continues, "is that the 18-inch instrument has an area of 254.5 square inches on the entire surface on which parallel light rays impinge, each of which has encountered equal air disturbance in its passage to the telescope, while the little eight inch has only 50.3 square inches of area, so can only collect on its surface five times fewer air-disturbed light rays; hence the atmospheric handicap at any one time is five times greater for the 18-inch telescope which, if used through no air at all, suppose on the airless moon, could only afford a defining power of a little over twice that of its small



Harold A. Lower, 1032 Pennsylvania Avenue, San Diego, California, who with his father built a telescope



Mr. Lower with the completed telescope. The figuring was done on an H C F lap, which proved satisfactory

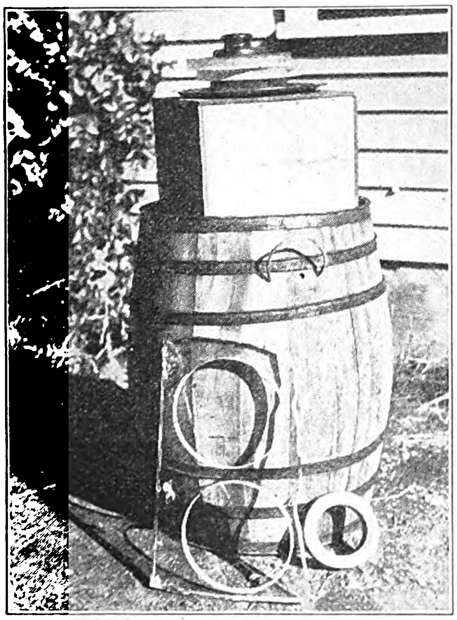


Mr. Lower inscribed this photograph: "Dad beveling the edge of the mirror disk. This is the rig we used for cutting out the disks"

competitor, the eight-inch instrument."

In the last statement Mr. Merlin is referring to the fact that the resolving or defining power increases in direct proportion, not to the mirror's area, but only to its *diameter*. If we divide 4.56 seconds of arc by the diameter or aperture of our mirror or objective lens we get what is called the "Dawes Limit." (See Bell, "The Telescope," Chapter XI). For example, consider a six-inch mirror. Performing this simple feat of arithmetic we ascertain that this size ought theoretically to resolve or separate two stars not closer than 0.76″ apart—although closer pairs can sometimes be seen elongated, their diffraction disks overlapping.

Separating a close double is essentially and optically the same thing as defining



The simple grinding rig. The lead weight applies added pressure. The picture also shows glass with disks cut out by rotary "cookie cutter"

Industry's Mainstay
-and yours

Few realize how the individual, as well as industry, is dependent upon wire rope — the great flexible "handler" of practically everything.

The illustration shows a great slab of concrete bridge flooring being lifted onto a freight car.

All the material in a modern skyscraper is handled with wire rope—in the "raw"; in shipping; in the actual building erection.

Oil wells are drilled with wire rope; mines are mined and quarries quarried with it. Your furniture and the evening newspaper both originated in logs taken from the forests with wire rope.

Yellow Strand Wire Rope will usually be found where real stamina is demanded. Not mere strength, but strength so nicely balanced with elasticity, flexibility and resistance to the crystallizing effect of vibration, that long life under severest conditions is assured.

One *strand of yellow* distinguishes this high quality rope from all others.

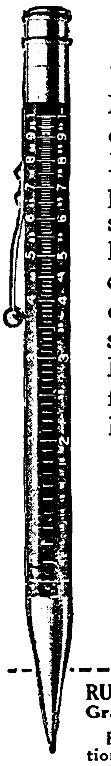
Broderick & Bascom Rope Co.
St. Louis, Mo.
Eastern Office and Warehouse: **68 Washington Street, New York**
Western Offices: **Seattle and Portland, Ore.** ***Factories:*** **St. Louis and Seattle**
Manufacturers of nothing but wire rope for over half a century.

Yellow Strand
WIRE ROPE

Aerial Wire Rope Tramways designed by this company have features that insure economical operation.

N790R55

A NEW SMART GIFT FOR MEN



HERE'S a new kind of gift for a *man*. Called "the pencil with a brain." Multiplies — Divides — Solves difficult mathematical problems *instantly*—without setting pencil to paper. Just set the slides and read the answer—yet has all the features of any first-class mechanical pencil. Standard Model—(outside metal sterling silver - filled) $5.00. Executive Model (14K gold-filled, in choice of colors) in handsome gift box $10.00.

Order now.

RUXTON MULTI-VIDER CORPORATION,
Graybar Building, N. Y. City

RUXTON
MULTI-VIDER
PENCIL

RUXTON MULTI-VIDER CORP., Dept. 17A
Graybar Building, New York City

Please send me a Multi-Vider, with instructions for use. On arrival, I will pay the postman price quoted below plus a few cents postage. Within 5 days, if not satisfied, I may return the Multi-Vider and you are to return my money. I am checking the model I want. ( ) Standard Model $5.00. ( ) Goldfilled Executive Model in a variety of colors, in handsome gift box $10. Specify color for Executive Model—Blue, Green, Maroon, Black, Crimson and Black.

Name..

Address..

City.......................... State...........

BOILER FEED WATER TREATMENTS
of purity and all other required characteristics.
Pamphlet on request
SIME, DARBY & CO., Singapore, S. S. *Agents for Straits Settlements.*
UNISOL MFG. CO., Jersey City, N.J., U. S. A.

Improved Reception
from your present radio is now made possible by the—

RADIO CLARIFIER
$3.00 Postage Prepaid

It clears the tone, decreases interference and increases volume. Overcomes fading of sound. Good for any wave length. Easily installed on inside or outside aerial. Simply cut wire near cabinet and connect between cabinet and aerial by using clips which are attached to Clarifier. Gives wonderful results. Satisfaction guaranteed. Worth many times its cost. Send $3.00 for immediate delivery. Descriptive literature on request.

ROAT & LOHMAN, Dept. 404, Milton, Pennsylvania

minute detail on, say, the moon. Resolving power, and therefore *aperture*, is here the decisive factor. But, as we shall see later, there is a fly in the ointment: much of what we gain thus we lose in lack of contrast.

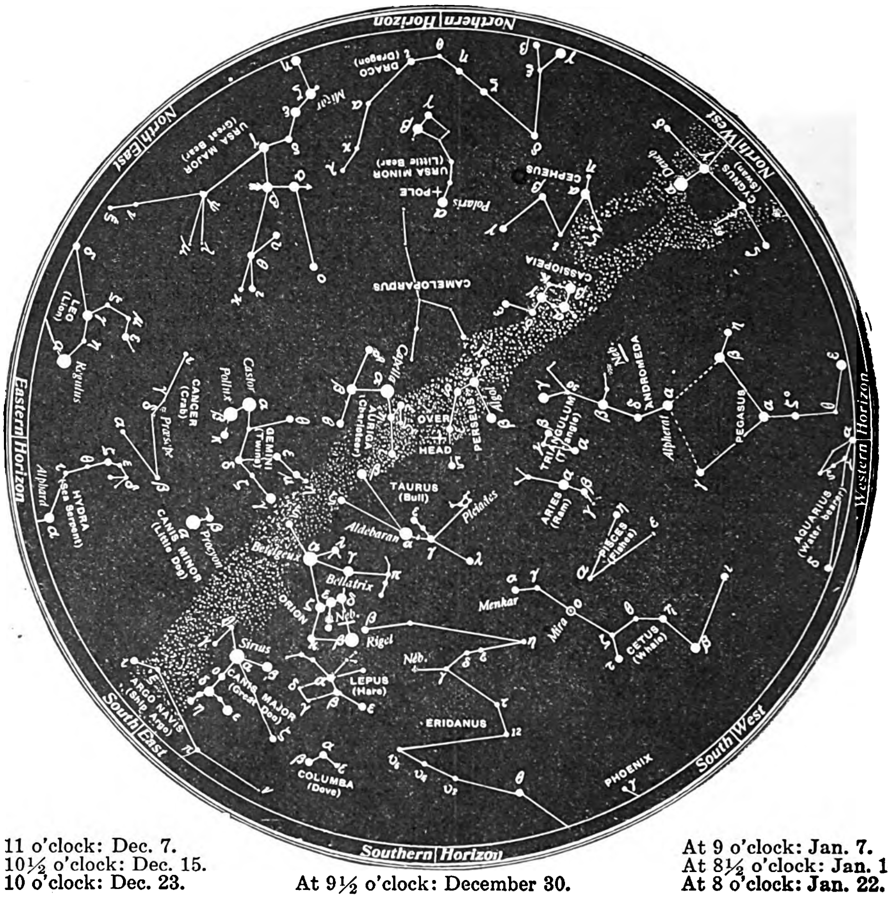
Professor A. E. Douglass, now Director of the Observatory at the University of Arizona but then on the staff of Lowell Observatory, published in *Popular Astronomy*, June, 1897, a long article entitled "Atmosphere, Telescope, and Observer," laying down certain basic principles which are equally valid in 1929 as in 1897, or any time. We shall quote salient parts of Prof. Douglass' article in a later number.

The *Journal of the Royal Astronomical Society of Canada* for October contains an interesting list of the reflecting and refracting telescopes of the world, compiled by W. E. Harper. In the list of reflectors we find two instruments made from the instructions in the book "Amateur Telescope Making," one being that of G. H. Hamilton, of Jamaica, B. W. I., a 21 inch described in our issue of last May, and the other that made by Steber and Thurn, of Warren, Pa., described last June.

These two lists, as complete as the compiler could make them, show the world's telescopes above 15 inch distributed among sizes as follows: 100 to 50 inches, eight reflectors; 50 to 40 inches, five reflectors, two refractors; 40 to 30 inches, 24 reflectors, six refractors; 30 to 20 inches, 20 reflectors, 29 refractors; 20 to 15 inches, 15 reflectors, 56 refractors. No telescopes under 15 inches are listed—which lets out most of us who "roll our own." If what Mr. Merlin writes is correct, we amateurs are a wiser lot than we supposed.—*A. G. I., Tel. Ed.*

The Heavens in December

By PROF. HENRY NORRIS RUSSELL, Ph.D.


Northern Horizon
North East
North West
Eastern Horizon
Western Horizon
South East
South West
Southern Horizon
DRACO (Dragon)
Mizar
URSA MAJOR (Great Bear)
URSA MINOR (Little Bear)
+POLE
Polaris
CEPHEUS
CYGNUS (Swan)
Deneb
CAMELOPARDUS
CASSIOPEIA
LEO (Lion)
Regulus
CANCER (Crab)
Praesepe
Castor
Pollux
GEMINI (Twins)
Capella
AURIGA (Charioteer)
OVER HEAD
PERSEUS
Algol
ANDROMEDA
Neb.
TRIANGULUM (Triangle)
Alpheratz
PEGASUS
TAURUS (Bull)
Pleiades
Aldebaran
ARIES (Ram)
PISCES (Fishes)
AQUARIUS (Water bearer)
Alphard
HYDRA (Sea Serpent)
CANIS MINOR (Little Dog)
Procyon
Betelgeux
Bellatrix
ORION
Neb.
Rigel
Menkar
Mira
CETUS (Whale)
Sirius
CANIS MAJOR (Great Dog)
LEPUS (Hare)
ARGO NAVIS (Ship Argo)
ERIDANUS
COLUMBA (Dove)
PHOENIX

At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9½ o'clock: December 30.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

NIGHT SKY: DECEMBER AND JANUARY

MERCURY is an evening star but is so far south in the sky that he will be hard to see. At the end of the month when conditions are best he sets at 6 P.M. Venus is still a morning star but is getting behind the sun. At the year's end she rises only 40 minutes before him and will no longer be easy to see. Mars is in conjunction with the sun on the 3rd and is unobservable. Jupiter is in opposition on the 3rd and is the brightest thing in sight except the moon, and is visible all night. His first and third satellites cross the disk on the evening of the first between 8 P.M. and midnight, while the second satellite is hidden behind the planet. This exhibition is repeated on the 8th between 11 P.M. and 2 A.M. Saturn is in conjunction with the sun on the 25th and can be seen only at the beginning of the month, just after dark. Uranus is in quadrature east of the sun on the 29th and is observable in the evening; while Neptune crosses the meridian between 3 and 5 A.M., so that the astronomer who would study it must rise early.

The moon is in her first quarter at 5 A.M. on the 9th; full at 7 A.M. on the 16th; in her last quarter at 9 P.M. on the 23rd; and new at 7 P.M. on the 30th. Her path in the heavens takes her near Mars and Mercury on the first, Saturn on the 2nd, Uranus on the 10th, Jupiter on the 15th, Neptune on the 21st, and Venus, Mars, and Saturn on the 30th.

The Scientific American Digest

(*Continued from page* 527)

culty. Because of the freight rates involved, however, a different type of fuel gas was used on each of the four legs of the voyage. It was decided that ethane would be the ideal gas to use as it is about the same weight as air and has a high fuel value. This gas was accordingly used on the first leg of the flight from Lakehurst to Friedrichshafen, having been shipped to Lakehurst in steel cylinders from a recently constructed ethane plant of the Union Carbide and Carbon Chemicals Corporation in West Virginia.

At Friedrichshafen the ship was refueled with Blau gas for the flight to Tokio.

At Tokio the ship was refueled with a mixture of Pyrofax and hydrogen. Pyrofax is commonly known to householders as a fuel for gas ranges in homes beyond gas mains. It was supplied in steel cylinders. Although it is somewhat heavier than air, a sufficient volume in the liquefied state could be much more cheaply transported from West Virginia to Tokio than could an equal volume of ethane. Therefore it was used, mixed with half of its volume of hydrogen, obtained in Tokio, to make the weight of the mixture approximately the same as that of air.

For the last leg of the flight from Los Angeles to Lakehurst, Pyrofax was shipped to Los Angeles where it was mixed with natural gas in suitable proportion. Shipment was made this time in tank cars, still further reducing the cost of transportation.

Thus the huge dirigible was supplied with suitable fuel gas at all points by means of an ingenious combination of various gases now commercially available in industrial centers throughout the world—a feat which would have been unthought of a decade or so ago.

Golf Ball Murders 74,000—Fish!

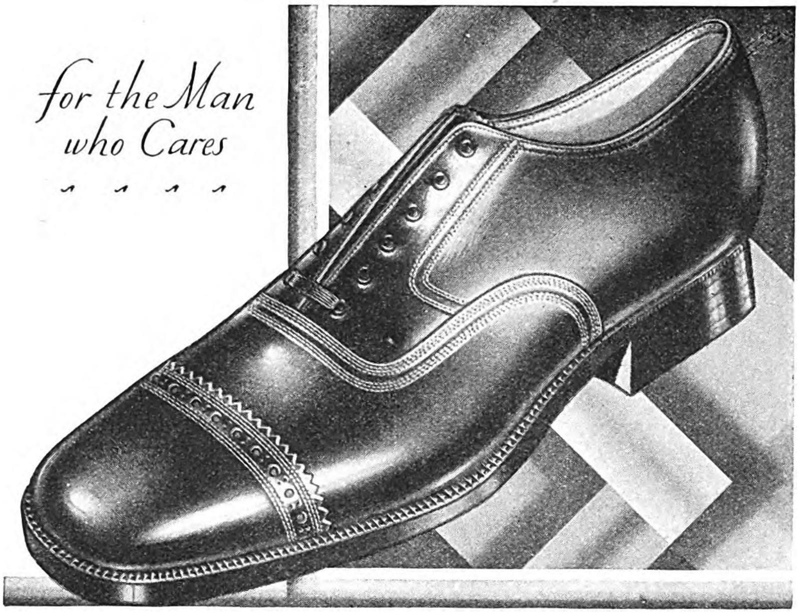
GOLF is charged with the murder of 74,000 fish at Glacier National Park fish hatchery. A player sliced badly, the ball entered and clogged the intake water line and the thousands of fish had no water in which to swim.—*Science Service.*

Burn Aluminum Dust for Intense Flame

A FLAME so intense as to melt its way through any known solid substance is produced by a new type of blowpipe, employing finely powdered aluminum instead of the more familiar hydrogen or acetylene gases. The new invention was described in Minneapolis recently by Dr. Frank M. Strong of Syracuse University, speaking before members of the American Chemical Society.

Dr. Strong described his device as follows:

"A screw conveyer carries a slow stream of aluminum dust from the bottom of a hopper out through the open end of a brass pipe. The dust is here met by a swift cross-stream of oxygen, with which it forms a fine and uniform suspension. From this point the mixture is passed forward through a larger tube, which a little farther along is divided up into eight smaller tubes. The latter diverge from the central tube for a short distance, and are then curved back inward so as to come to a sharp focus. The aluminum-oxygen flame can be lighted at this focus



The FLORSHEIM *Shoe*

RELY on FLORSHEIM SHOES for service... their many years of dependable performance is a criterion of quality...they have always made good...and they will today

Most Styles $10
THE STRIDE... *Style* M-376

THE FLORSHEIM SHOE COMPANY
Manufacturers · Chicago

WANTED —an opportunity to back engineers with new ideas for the improvement of airplanes. If we feel your inventions are practical we will help you develop them.
ALEXANDER AIRCRAFT CO., Dept. 8, Colorado Springs, Colo.

ASTRONOMICAL
TELESCOPES
Send for Catalog
WM. MOGEY & SONS, Inc.
PLAINFIELD, N. J.

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

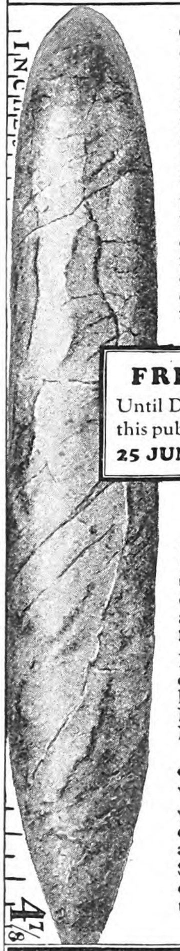
TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

FREE 25 Edwin's Jr. PANATELAS
With Your First Order for
50 Edwin's OLD TIME STRAIGHTS $2.10
15¢ Quality Guaranteed



75 CIGARS AT LESS THAN 3¢ A PIECE

Made of genuine imported Picadura, from our own plantations. Same quality tobacco as used in **15¢** Cigars.

HOW WE CAN AFFORD IT

We do not spend a cent for bands, decorated labels or fancy boxes. We do not risk a cent on credit. We save money by mass production. We buy large quantities of the finest tobacco direct from the grower in Cuba, for spot cash.

FREE TO DEC. 31st

Until Dec. 31, we will give readers of this publication, with their first order **25 JUNIOR PANATELAS FREE**

YOUR MONEY BACK

—if you don't get *three times* the value in supreme smoking pleasure. Smoke as many of these cigars as you like—all if you wish and if you are dissatisfied we'll **REFUND YOUR MONEY IN FULL**

I have been making cigars for over fifty years. My company has been established since **1903**. Reference: National City Bank, New York, or any bank in Cuba.

JUST ONE STIPULATION

We reserve the right to return your money after the limited quantity of Junior Panatelas available has been distributed. Send in your order today with check or pay postman. We pay the delivery charges.

DIV. Y EDWIN CIGAR CO.
2338-40 THIRD AVE.—NEW YORK

Christmas Gift

Strange Tales
from the
Frontiers of Science

Science News-Letter is a weekly enjoyed by the general reader who thrills to the new and unusual. It has a specific appeal to those with a scientific leaning.

Science News-Letter brings news from *Nature's great outdoors* . . . insects . . . wild flowers . . . beasts and birds of the field and forest . . . fish and creatures of the sea.

Ancient civilizations are made to live again by the spade of the archaeologist . . . *adventures in strange lands* . . . explorations . . . provide romantic stories in Science News-Letter.

When *astronomers probe new universes* . . . or amateurs chase meteors . . . when chemists and physicists discover elements in the making . . . you can star-gaze, guided by maps in this weekly.

Science News-Letter makes a fine and an intelligent Christmas Gift.

SCIENCE NEWS-LETTER
Gift card covering year's subscription $5.00.
Introductory offer { **$1 for 13 weeks** / **$2 for 6 months** }
2121 B Street, Washington, D. C.

point with a match or Bunsen burner."

Dr. Strong's blowpipe combines the principles of the familiar oxy-hydrogen or oxy-acetylene blowpipes with that of thermite, a powder used for the generation of intense heat on a limited area, such as the ends of rails in welding. Thermite consists of aluminum powder mixed with another chemical which on heating yields free oxygen at a rapid rate. In the new blowpipe the oxygen is supplied directly in the form of a gas instead of being generated on the spot from a chemical. —*Science Service.*

Cave Man's Brain Found in Russia

A RARE find of human brains, representing our ancestors thousands of years ago, has been announced from Odinzowo, near Moscow, in central Russia. The two petrified brains were found associated with the teeth of a wooly mammoth, and they were without doubt the very oldest fossilized human brains ever found.

It is reported that a commission of scientists has been selected to make detailed studies of these remarkable finds of man during the ice age when the huge mammoths and the rhinoceros were clothed with a thick coat of wooly hair.

These rare finds are not "casts," but actually petrified human brains, somewhat shrunken, to be sure, but sufficiently well preserved so that anatomists can reconstruct the form of the brains from the fossils.

The cave man was equipped with a goodly supply of gray matter. The Russian scientist, Hindze, who is preparing a report on the fossil brains, is of the opinion that man in the ice age possessed a brain slightly smaller and less developed than recent dwellers of the same area —*Science Service.*

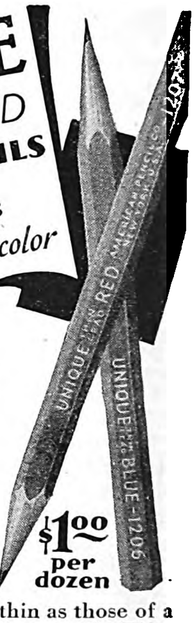
Prehistoric Indian Dentists Filled Teeth

MAYAN Indians who lived in Central America more than 1000 years ago practiced dentistry and knew something about the technique of drilling holes in teeth and filling up the cavity with metal. Two teeth containing circular holes filled with iron pyrites are among the significant discoveries reported by J. Eric Thompson, leader of the Captain Marshall Field Archeological Expedition to British Honduras, which has just returned to the Field Museum of Natural History.

The teeth were found in a vaulted burial chamber in the ruins of the Mayan city of Tzimin Cax, which means "Mountain Cow." A good collection of Mayan painted pottery was found in the chamber. Other burial chambers yielded skeletons and pottery types hitherto unknown in the Mayan art, also jade ear-plugs and apple-green jade beads.

While digging in a large mound in the ruins of the city, the expedition made the first authenticated find of a mirror from a site of the Old Empire of the Mayan tribes, that is, from the period between 400 and 800 A.D., Mr. Thompson states. The object consisted of a number of small squares of iron pyrites, which apparently had made a shiny metal looking-glass with a pottery back. Heretofore, it has been generally supposed that the inhabitants of the early Mayan cities were unacquainted with the use of mirrors.—*Science Service.*

UNIQUE TRADE MARK REG'D.
THIN LEAD
COLORED PENCILS
24 Colors
Make fine lines in color



UNIQUE pencils have even more uses than they have colors. They appeal to everybody who wants to do neat fine work in color . . . such as checking, sketching, underscoring, map coloring, correcting blueprints, proof reading, etc.

$1.00 per dozen

UNIQUE leads are as thin as those of a No. 2 VENUS black writing pencil. They can be sharpened to a needle point.

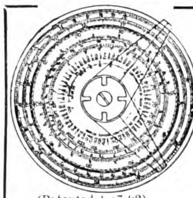
12 Colors (Asst. No. 1116) *per box* $1.00
24 Colors (Asst. No. 1117) " " $2.00
At all dealers or write direct
American Pencil Co., 542 Venus Bldg., Hoboken, N.J.

A VENUS Pencil Factory Product

WANTED MEN
To Manufacture Metal Toys and Novelties

Big demand for Toy Soldiers, Animals, 5 and 10c Store Novelties, Ashtrays, etc. We co-operate in selling goods you make also buy them from you. Small investment needed to start and we help you build up. WE FURNISH COMPLETE OUTFITS and start you in well paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life time for man with small capital. CHRISTMAS RUSH is now starting, so if you mean strictly business write AT ONCE for full information.

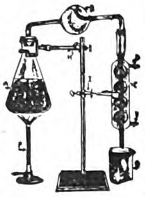
METAL CAST PRODUCTS COMPANY
Dept. S 1696 Boston Road New York City



(Patented 1-17-22)

The Midget
***"Five-in-One"* Slide Rule**

is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Fabrikoid Case, 50c extra. Sent C. O. D. if desired. Catalogue Free. **GILSON SLIDE RULE CO., Stuart, Florida**



CHEMISTS

Catalog illustrating 2500 Chemist's Supplies, 5000 Chemicals, Minerals, Drugs, etc., and listing 1000 Scientific Books sent for 50c. Glass Still, as illus. cap. of flask 1 Qt. complete $8.

LABORATORY MATERIALS CO.
637 East 71st Street, Chicago.

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

ASBESTOS

All grades of Crudes
and Fibres in large
or small quantities

Sold by

KEASBEY & MATTISON
COMPANY
Ambler, - Penna.

Branches in Principal Cities

Chemistry in Industry

(*Continued from page* 534)

at 20 degrees, Centigrade, proved harmful to tench, which are noted for their tenacity of life, after a period of three hours and five minutes. The tench were then removed to fresh water and died three days later. However, a one-tenth of one percent solution of calcium chloride had but slight effect upon trout and tench when the temperature of the water was six degrees, Centigrade.

Numerous investigators have shown that many fresh-water fish will die if subjected to the action of water of high salinity; the ill effects are largely attributed to the unbalancing action of water of greater specific gravity, a diminution of some of the essential food, and also, tendency toward loss of water from the body of a fresh-water fish when placed in a salt solution; this latter phenomenon is explained by the theory of osmosis. Bass transferred from fresh water directly into sea water died in a few minutes. However, a transfer of bass and perch from fresh water to a sodium chloride solution containing approximately 14,000 parts per million failed to produce any fatalities in 14 days.

Those interested in further details as to the effect of impurities in streams on native fish will find a vast fund of information available at the United States Bureau of Fisheries, Washington, D. C.

Novel Method for Making Citric Acid

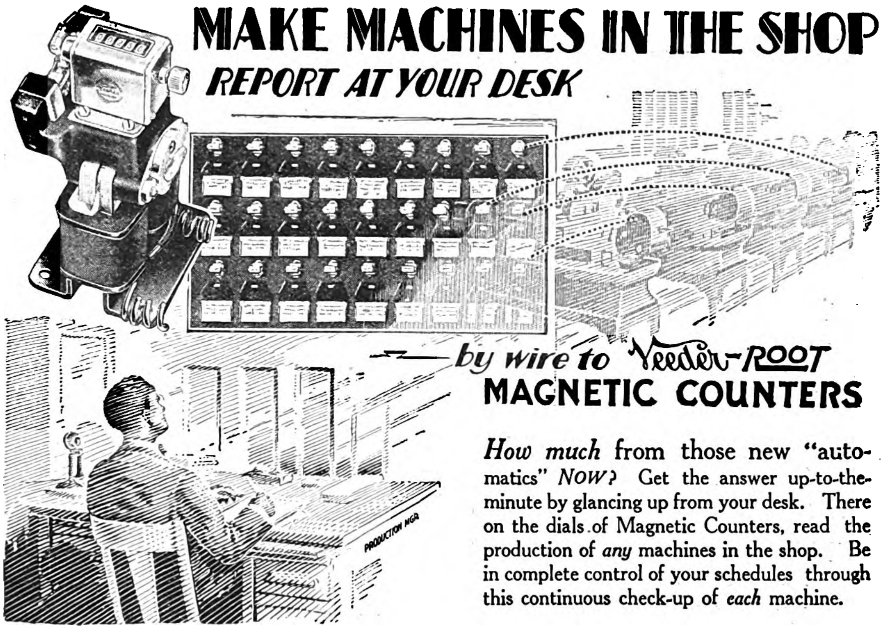
CITRIC ACID from lemon juice and similar raw materials without the intermediate production of citrate of lime, has been worked out by Professor Dr. C. Crotto of the School of Pharmacy in Buenos Aires, says a recent issue of "*Quimica e Industria.*" The elimination of the usual step of neutralizing the acid of lemon juice with lime to form calcium acetate is expensive and the yield poor, so that this novel process promises appreciable savings.

In outline the process is as follows: The lemon juice is concentrated in vacuo to the consistency of a semi-solid and is then macerated with acetone, the weight of acetone used being double that of the concentrated juice. The albuminous, pectic, mucilaginous, and other insoluble substances are separated by filtration and the filtrate treated with half of its weight of distilled water. The citric acid dissolves in the water and the acetone is separated and recovered. The process is patented and is stated to give perfectly satisfactory results on a semi-large scale.

Rust Used in New Base for Paint

RUSTY tanks for oil storage or other exposed iron surfaces require cleaning as a preparatory to receiving a protective coat of paint; this is a laborious and consequently costly process. A recently patented means to preserve the metal consists of applying a mixture which penetrates the rust layer, forms a base for paint of which the rust is a part, and prevents further corrosion.

The material is said to have the additional advantage of resisting the solvent action of gasoline and other mineral or fatty oils. First an emulsion is made with linseed oil and alkali. Second, casein and silicate of soda are made into a smooth, viscous mass and mixed with the oil emul-



MAKE MACHINES IN THE SHOP
REPORT AT YOUR DESK

by wire to Veeder-Root
MAGNETIC COUNTERS

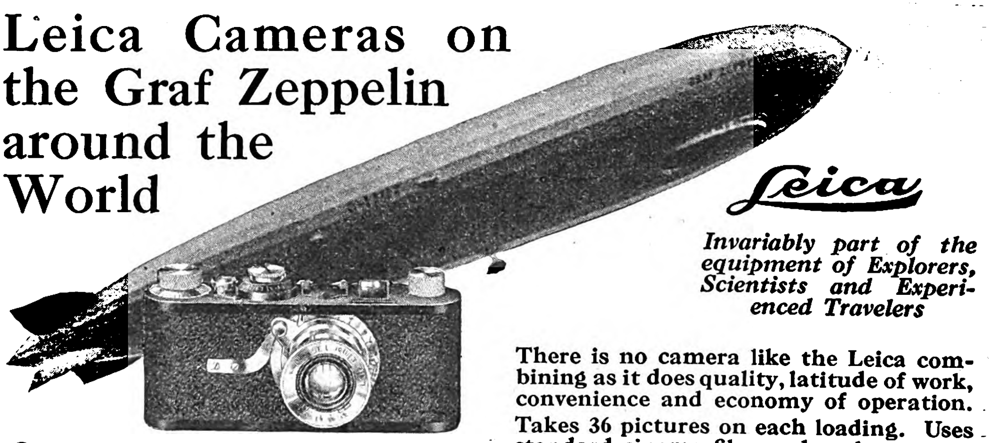
How much from those new "automatics" *NOW?* Get the answer up-to-the-minute by glancing up from your desk. There on the dials of Magnetic Counters, read the production of *any* machines in the shop. Be in complete control of your schedules through this continuous check-up of *each* machine.

Mechanical contacts on machines make and break the electrical circuits which operate the counters over your desk, or "banked" conveniently on a Counter-Board. The electro-magnetic drive of the counter gets its current from your regular lighting circuit: *Alternating current* either 55, 110 or 220 Volts as ordered. Also furnished for operation by direct current or storage battery.

Write for new Catalogue with the data complete.

Veeder-Root INCORPORATED HARTFORD, CONN.

Offices in the Principal Cities; write or phone.



Leica Cameras on the Graf Zeppelin around the World

Leica

Invariably part of the equipment of Explorers, Scientists and Experienced Travelers

ON the Graf Zeppelin's west bound trip one of the several Leica Cameras on board was used to photograph the *interior* of the torn bag. Motion prevented time exposures—the only light was that reflected from the ocean through the ripped opening, yet the pictures were remarkably clear.

Several Leicas accompanied the Byrd Antarctic Expedition. Six more have been ordered by radio since the intrepid men reached their winter base.

The Leica is known and used throughout the world by scientists, engineers and those who follow the advancement of photography.

There is no camera like the Leica combining as it does quality, latitude of work, convenience and economy of operation.

Takes 36 pictures on each loading. Uses standard cinema film and each negative is of double framesize—the first camera to have this feature. The smallest roll-film camera with focal plane shutter.

May be used for snapshots, portraits, indoors or outside. Used by engineers for recording data and by scientists for photo-micrographs. Always ready for instant use.

Leica enlargements to 12" x 18" or larger, preserve beauty and detail. Mechanically and optically the Leica is a model of perfection.

See the Leica at your dealer's. He will gladly demonstrate it for you. Or write for illustrated literature. E. Leitz, Inc., 60 East 10th St., New York, N. Y.

E. LEITZ, Inc., Dept. S. A. 5, 60 East 10th St., New York, N. Y.
Please send me catalog on the Leica Camera.

Name..

Address..

Fits Vest Pocket or Purse

DEAFNESS

The
"PHONAK"
A new scientific
hearing aid
now available

Clarity and purity of tone
Quietness of Operation
Adequate Volume and Range
No Crackling
or Hissing Sounds
from the
Electrical Currents

FRENCH ELECTRIC CO., Inc.
654 Madison Avenue
New York
GEORGE BARTON FRENCH
PRESIDENT
Circular on Request

Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE

At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.

$5.00
for Complete
Outfit Prepaid

ROAT & LOHMAN
Dept. 102 Milton, Pa.

Eldis' SPORT GLASS
VEST POCKET

Get the Habit—Carry Them Always in your pocket!

Compact—have them with you at football games, races, ringside and outdoors. Different, powerful with wide field of view (265 yds., at 1000 yds.); 90% luminosity. Beautifully finished. Every one would be delighted to own an "ELDIS" 3 1-2 inches long; 1 5-8 inches high; 1 3-16 inches wide. Weighs 4 oz. Soft leather pouch. Blue, jade or tan finish **$13.50; Black $13.**

Ask Your Dealer—sent direct if he cannot supply. Money back guarantee.
Write for folder "M".
Dealer's inquiries invited.

AMERICAN THERMO-WARE CO., Inc.
Exclusive Importers—Est. 1901
16 Warren Street
New York

sion. Whiting and zinc oxide are stirred in, and colored pigments may be added if desired; a preservative such as phenol or salicylic acid may be added in small amount if the mixture is to be stored before use. It works best on rusty surfaces to which it adheres firmly, and when dry makes an economical base for paint. The process is covered by United States patent 1,647,-666.

Processes Developed to Bind Fixed Nitrogen

An interesting series of processes utilizing phosphate rock to bind fixed nitrogen has recently been introduced into this country by the Dorr Company, Inc. The processes were developed by Frans G. Liljenroth, a prominent Swedish engineer whose name has been associated with some of the pioneer work in developing phosphoric acid technology.

Kunstdunger Patent Verwertungs A. G., of Switzerland, has been formed as a patent holding corporation and will continue research work in connection with nitrogen binding and the production of concentrated synthetic fertilizers.

The Dorr-Liljenroth processes bind from 20 percent to 70 percent of the nitrogen in the form of concentrated mixed fertilizers containing from 40 to 70 percent total plant food and the remainder as ammonium sulfate and calcium nitrate containing from 14 to 21 percent nitrogen.

It is claimed that the over-all binding cost of a plant with a capacity of from 20,000 to 25,000 tons of ammonia per year will be from 0.6 to 1.2 cents per pound, depending on the type of materials produced.

Regulating Thickness of Electro-Plating

Electroplaters are already making use of instruments for measurement and control of temperature, pressure, and acidity in electrolytic baths. But another necessity is to control the thickness of the deposit by suitable regulation of the current density. To meet this need, the LPW current density meter has been developed abroad and is described by W. Pfanhouser in *Chemiker-Zeitung*. It consists of two round comparator electrodes in a hard rubber housing, insulated from each other and connected together across a small meter. The instrument must be calibrated according to the solution in which it is to be used and must be placed in proper position with respect to the anode and cathode. It serves to show the time required for a given thickness, and also helps maintain quality by keeping the current density within proper limits.

Ferric Chloride Becomes Cheap Coagulant

Strictly speaking, ferric chloride in solution is not a new coagulant, but for many industrial purposes its price has prohibited its use. Recently, however, ferric chloride has appeared on the market in commercial quantities at prices which make it economical for use in sewage disposal systems and for other coagulating functions. *Industrial and Engineering Chemistry* comments on this significant development as follows:

"It frequently happens that the adoption of a material for a particular large-scale

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents
and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS' MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea
BERNARD & HELLER LABORATORY
Labor Saving Machinery Designed & Built
Circular - References - Guarantee - Free
BERNARD & HELLER ~ 31 East 17th St., N.Y.C.

I SELL PATENTS

If you wish to add New Products to your line, or have a good Patent to sell, write me—

CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

CRESCENT -TOOL- COMPANY
Inventors--We Build Models
Send us your rough idea. Our Master Mechanics will develop it for you into a practical working Model. Thirty years successful experience doing this very thing. Best shop equipment. Expert advice. Confidential service guaranteed. Bank reference furnished. Send for free booklet "The Road To Success."
CRESCENT TOOL CO., Dept. C. Cincinnati, Ohio

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

WANTED
For manufacturing and selling by a prominent, long established Massachusetts concern, **special or patented equipment** for Water Storage Reservoirs, Filtration Plants, Irrigation Development. Liberal royalties on exclusive manufacturing basis. Address BOX 193, SCIENTIFIC AMERICAN, New York City.

WANTED PATENTED SPECIALTIES
Desire articles which can be stamped from sheet metal and pertaining to automotive, radio, or hardware lines. If attractive to us will either buy outright or make satisfactory royalty arrangement. Send full information and drawing. Over forty years in business.

THE OTTO KONIGSLOW MFG. CO.
3500 Perkins Ave. Cleveland, Ohio.

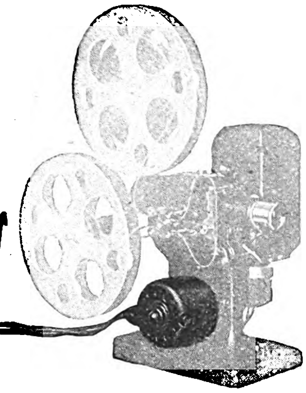
HAVE YOU AN ELECTRICAL PROBLEM?
WE SPECIALIZE IN "PERSONAL SERVICE", and *solve them for YOU through the mail with Precision. Write us now.*
TAHSESAEB, P. O. No. 132, FLUSHING, NEW YORK

MONEY

MYSTERY GAS LIGHTER

JUST OUT. LIGHTS GAS INSTANTLY WITHOUT SPARKS OR FLAME - SELLS LIKE WILDFIRE WHEREVER GAS IS USED —RETAILS FOR 25¢
MAKE $25. A DAY
SAMPLE FREE
PACKED ON INDIVIDUAL CARDS WITH INSTRUCTIONS
RUSH $10.00 FOR GROSS OR 1.00 FOR DOZ.
NEW METHOD MFG. CO.
Desk SA-12 Bradford, Pa.

MONEY

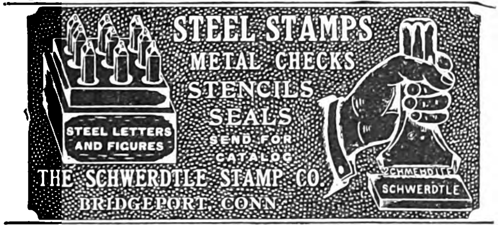


It's the Motor

Whatever the projector flashes on the screen . . . your vacation trip . . .your hunting trip . . .your little tots . . . remember it's the motor that furnishes the action . . . that is the heart of the projector. And, in this projector (reproduced above) it's a Signal Fractional Horsepower Motor—selected because the motor will render dependable service with low consumption of current. No better motor could be put into such a device . . . another use for small motors. Signal Fractional Horsepower Motors—either induction or series wound — are designed from experience to meet manufacturers' needs for hundreds of different appliances. Perhaps our experience can help you, too.

SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan
Small Motor Specialists Since 1890

SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS



STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
STEEL LETTERS AND FIGURES
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.
SCHWERDTLE

BECOME A FOOT CORRECTIONIST

$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.

STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

AIRPLANE DRAFTING

THOUSANDS OF MEN

will make fortunes in Aviation. Airplane Drafting and Designing are the biggest jobs ahead in this fastest growing industry. A new field of opportunity for you is opened in our improved method of training.

EASY TO LEARN. STUDY AT HOME. PAY AS YOU GO. EMPLOYMENT SERVICE.

Write for booklet outlining courses in Airplane Drafting and other aviation subjects, including the famous Weem's System of Navigation—endorsed by Col. Lindbergh, Commander Byrd, Lincoln Ellsworth, Admiral Moffett, etc.

Name..................................
Address..................................
City......................State..........

☐ AIRPLANE DRAFTING
☐ AIRPLANE MOTORS D ☐ AIRPLANE MECHANICS

PACIFIC TECHNICAL UNIVERSITY SAN DIEGO CALIFORNIA

use leads to its manufacture in such quantities as to bring the price within the reach of others long interested but not able to buy. It is in this connection that we note with interest a contract recently awarded the Pennsylvania Salt Manufacturing Company by the Sewerage Commission of the City of Milwaukee, calling for between 2000 and 2500 tons per year of ferric chloride in solution at a price of $2.08 per hundred pounds on the anhydrous basis, delivered at the sewage plant.

"The solution will be transported in rubber-lined tank cars and will replace chlorinated copperas heretofore used. The availability of ferric chloride in solution in quantities that will greatly reduce its price would seem to open up a number of possible applications and make it a direct competitor with the older coagulants.

Lignite Absorbs Sulfur Gases

AN interesting process for sulfur removal from gas is reported by Dr. F. Neuwirth, a German chemist. In the research laboratory of the Oesterrichischen Montangesellschaft it was found that a local ligneous coal, steam-dried, had a great absorptive affinity for various gases and behaved much like activated carbon. Slow passage of a coal gas over this dried lignite resulted in the removal of 80 to 90 percent of the hydrogen sulfide, and simple treatment with superheated steam regenerated the coal for fresh use again. Similar trials with the coke from this coal, activated at 800 degrees, Centigrade, with CO_2 showed an even more active absorption.

Finally, similar trials with the raw ligneous coal gave the surprising result that it has by far the most favorable action, especially at a raised temperature of preferably 70 to 80 degrees, Centigrade, and that it could be regenerated by mere wetting with water. Quantitative tests after a 15th regeneration still showed a removal of 98 percent, 600 grains of coal absorbing 77.8 grains of sulfur. Sulfur dioxide was removable in the same way, in fact the process has suggested itself strongly for American use for various cracking gases and the like since it is quite probable that some native lignites possess the same strange property.

New Material for Crucibles Outpoints Porcelain

A NEW fireproof product intended to take the place of porcelain has been placed on the market, the product of a Holland manufacturer. Weta-material consists of very fine, uniformly distributed carborundum particles with admixed silicates and metals of the iron series, cobalt and nickel, and sinters, after firing in a porcelain kiln, at about 1400 degrees, Centigrade. A pot is obtainable which, without any glazing, is completely watertight. A glowing hot Weta-material crucible can be chilled in cold water without injury. The dark gray crucible can be used for qualitative and quantitative analyses and on account of its resistance to breakage is especially adapted for work under very high pressures. Weta dishes survive a large number of determinations without cracking due to decided changes of temperature, knocks, or blows. Tubes can also be produced from Weta-material for use in the manufacturing plant. Weta-material ranks somewhat better than porcelain crucibles from the state porcelain factory.

Will you invest $1.00 for 12 of the finest cigars that skill and experience can produce

Two cigars each of all six sizes that we sell regularly for $8.00 to $20.00 per 100.

BOUQUET DE ROSE
SAMPLE BOX

We want you to become familiar with the complete line of the Famous Bouquet de Rose Cigars.

Every cigar is made by hand in our own factory, filled with the finest Havana tobacco grown. Our representative in Cuba procures the choice leaves from the richest crop Cuba produces. You cannot duplicate these cigars anywhere else for half again as much money.

If you don't find them as represented, your money will be refunded in full.

We can afford to send only one sample box to a customer, at this special price.
Coupon below must be used.

MARVIN CIGAR CO.
364-376 CANAL PLACE, NEW YORK

Enclosed find $1.00 for which send me prepaid one Sample box of 12 Bouquet de Rose Cigars containing 2 cigars each of all six sizes that you sell regularly from $8.00 to $20.00 per 100.

☐ Mild ☐ Medium ☐ Strong

Name..
Address..
City......................State................17

CHICAGO TECH
FOUNDED 1903
ENGINEERING-ELECTRICITY
ARCHITECTURE-DRAFTING

4 Fields of real opportunity. Big pay—a permanent position or a business of your own. 7 Billion dollars spent last year in one of these fields alone. Train here in Chicago, America's industrial center. 1, 2 and 3 year courses. Diplomas and B. S. Degrees. *Special 4 months' practical course* in Drafting. Other short courses. Earn while you learn. Enter any time. Day and evening classes. No time wasted. Free Employment Bureau. Low tuition—easy terms. Athletics. Successful graduates everywhere. Free 80-page "Blue Book." Address the President, Chicago Technical College, Dept. R-57, 118 E. 26th St., Chicago, Ill.

250 POWER MICROSCOPE $16.50 16-
MADE IN U.S.A.

Educational, entertaining, this fine microscope helps all to know life that can't be seen with unaided eye. Tiny insects look like monsters. Plant and mineral life reveal new wonders in form and color. Used by students, dentists, physicians, scientists—in home, office, school and laboratory. Precise optical qualities.
Magnifies 100 to 250 times. Tilting stand, fine finish, nickel trim, plush-lined case, prepared slide, instructions. At your dealer or direct postpaid. Money back guarantee. Other models $2.50 to $8.50. Catalog Free

Wollensak Optical Company
914 Hudson Ave. Rochester, N. Y.

25 POWER $1
GERMAN POCKET MICROSCOPE

A marvelous German 25 power microscope, size of pencil, Enlarges diameter 25 times, area 625 times. Fine lenses give extra large field and great light. Only 4⅜ inches x ⅜ inch; weighs but one half ounce. Used in schools and colleges throughout the country. Fine for biology, geology, botany, nature study, examining stamps, finger prints, insects, cloth, metals, photographs and thousands of other things. Equipped with handy fountain pen clip. **40-50-60X, 1 1/2 oz. $4.**

$1 prepaid. Money back guarantee. Discount for 6 or more.

BINOCULARS **Over 200 Glasses All Makes $1-$110**

Everything in binoculars, field glasses, telescopes and optical instruments. The finest and largest assortment in America. Catalog gives all information how to choose the best for your individual needs at the LOWEST PRICE.

Try America's Leading Binocular House First
DuMaurier Co., Dept. 1612 Elmira, N. Y.

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe our way, per bend:

1-inch pipe	5 cts
2-inch pipe	10 cts
4-inch pipe	25 cts
6-inch pipe	60 cts
8-inch pipe	$1.00

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

Send for Catalogue

GEARS
In Stock—Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 70
CHICAGO GEAR WORKS
769-763 W. Jackson Blvd., CHICAGO, Ill.

SPRINGFIELD RIFLE, Model 1903
$19.50
Assembled and Refinished
8¾ pounds, 43 inches long, 24 inch barrel. Offered without bayonet, $19.50. Packing charge 50c extra. Ball cartridges $3.50 per 100. New catalog, illustrated, 380 pages of Army-Navy equipment, pistols, guns, uniforms, saddles, for 50 cents.
Special new circular for 2c stamp. *Established 1865.*
Francis Bannerman Sons, 501 B'way, N.Y. City

RADIO FREE CATALOG
AT WHOLESALE PRICES
196 pages of radio bargains. New Screen Grid, all-electric, A.C. Sets in beautiful consoles—also battery operated sets as low as $16.95. Write today.
ALLIED RADIO CORPORATION
711 W. LAKE ST., DEPT. 67 CHICAGO

TYPEWRITER ½ Price
World's best makes—Underwood, Remington, Royal—also portable—prices smashed to below half. *(Easy terms).*
SEND NO MONEY
All late models completely rebuilt and refinished brand new. *Guaranteed* for ten years. Send no money—big *Free* catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10 day free trial offer. Amazing values—send at once.
Free Trial
International Typewriter Exch., 231 W. Monroe St. Dept. 1260 Chicago

Learning to Use Our Wings

(*Continued from page* 529)

At the conclusion of the solo demonstration as slow a landing as the conditions permit is made and the plane is taxied smoothly over the ground. During the demonstration the salesman on the ground is carrying on his talk in tune with the demonstration. Immediately after an inspection of the plane, each of the prospects is sent up for a short smooth ride, during which an attempt is made to impress him with the steadiness and safety of the plane.

The newspapers are very fond of talking of airplane sales to the average American family, but the average American family is not yet in the market. The American Aircraft Corporation lists its best sales sources in the following order: the dealer, the flying student, the successful business man, and the weathy sportsman. It might seem strange that the dealers are included, but actually the dealers are themselves the heaviest users of light planes because of their school work, passenger hopping, and so forth. Students are all extremely anxious to buy planes, and generally select the type in which they have learned to fly. The business men are in a distinct group from the students. It is true that some successful business men learn to fly, but the majority either hire a pilot to fly for them or else learn to fly after the purchase. The wealthy sportsman is a comparatively easy man to sell.

Mr. Duelks voices one very wise thought. "However, selling the planes to people who will use them for sport and pleasure alone is not following the guiding star of the industry. Such sales will continue in fair volume for a while and should be sought after, but the saturation point is soon reached on any product which does not have the practical utility appeal which generates volume sales. There are many pleasure yachts sold each year, but there is a vastly greater number of electric refrigerators being sold. The airplane is primarily a tool of commerce and industry, and we believe that our business of selling airplanes must be built from the ground up on a solid foundation of commercial application."

American Passenger Air Transport—III

(*Continued from page* 517)

we were still lagging somewhat behind European practice.

We do not believe, however, that this condition will long prevail. Consider, for example, the air depot of the Western Air Express at Los Angeles, California. The depot is not large but it is built in attractive Spanish style. There is a general waiting room, a special waiting room for women, a ticket office, suitable lavatory space, and a roof garden. On cool days there is an open fire to welcome the passenger. Private automobiles are stored without charge. The airplane is brought directly to the front of the depot. Here an extensible canopied walk has been provided, which may be made to inclose the door of the airplane, so that passengers are under cover at all times, and protected from propeller danger. Uniformed attendants carry baggage and are not allowed to accept tips.

SEE THE MARVELOUS SPECTACLE
in the sky through your own telescope, and details 20 miles away, by day.
Reflecting mirrors, guaranteed accurate by test, furnished or ground to order, 6" to 12", $75 up.
Simple to make your own tube and mounting.
Prisms and eyepieces all sizes and powers.
C. A. OLSON, Box 363
Westwood New Jersey

Waterpower Engineering
Home Study for High School Graduates
H. von SCHON, Consulting Engineer
289 Parker Street, Newark, N. J.

Inventions AND Patents
By Milton Wright

Sound practical advice to Inventors, covering the entire field from the inception of the idea through to the legal forms of assignment, sale or royalty, with numerous hints suggested by the experience of many years practice.

($2.65 *postpaid*) DOMESTIC

SCIENTIFIC AMERICAN
24 West 40th Street
New York, N. Y.

The Municipal Airport at Oakland, California, on the east side of San Francisco Bay, one of the busiest airports in the United States, will, when completed, present an imposing architectural appearance. As an indication of what the American passenger terminal is already like let us quote from Hank's "International Airports": "The airport buildings consist of four hangars with suitable shop facilities, an administration building and an airport restaurant. The hangars are constructed of masonry and steel and are of ample size to shelter the largest of transport airplanes, the total area providing in excess of 20,000 square feet of clear floor space. Hangar doors are all of full width opening and the overhead clearance of each is 24 feet. Floors are of concrete and aprons of the same material have been constructed in front of the hangars. The restaurant seats 150 people and is modern in every detail. A lunch counter is provided for those desiring rapid service. The administration building contains the office of the airport manager and headquarters of the various transport companies operating from the airport. A complete weather display board has been installed in this building on which full weather reports are posted several times a day. A club house for the use of pilots is now being erected."

The Future of Passenger Travel

IT is always difficult to predict, but there are certain conclusions which may be readily drawn from present trends.

Safety comparable with that of rail travel will be achieved within a few years. Increased safety, increasing propaganda by the press, the tremendous superiority of the airplane as regards speed, will eventually make the public completely air-minded. Passenger air travel will then be on a tremendous scale. The net-work of airways will cover the entire country, giving air travel facilities to every city of any importance.

Cruising speeds will gradually approach 200 miles per hour. Night flying for passengers and sleeper airplanes will become commonplace. Further improvement in the structure, aerodynamics, and power plant will greatly increase the pay-load capacity of an airplane. So will re-fuelling in the air.

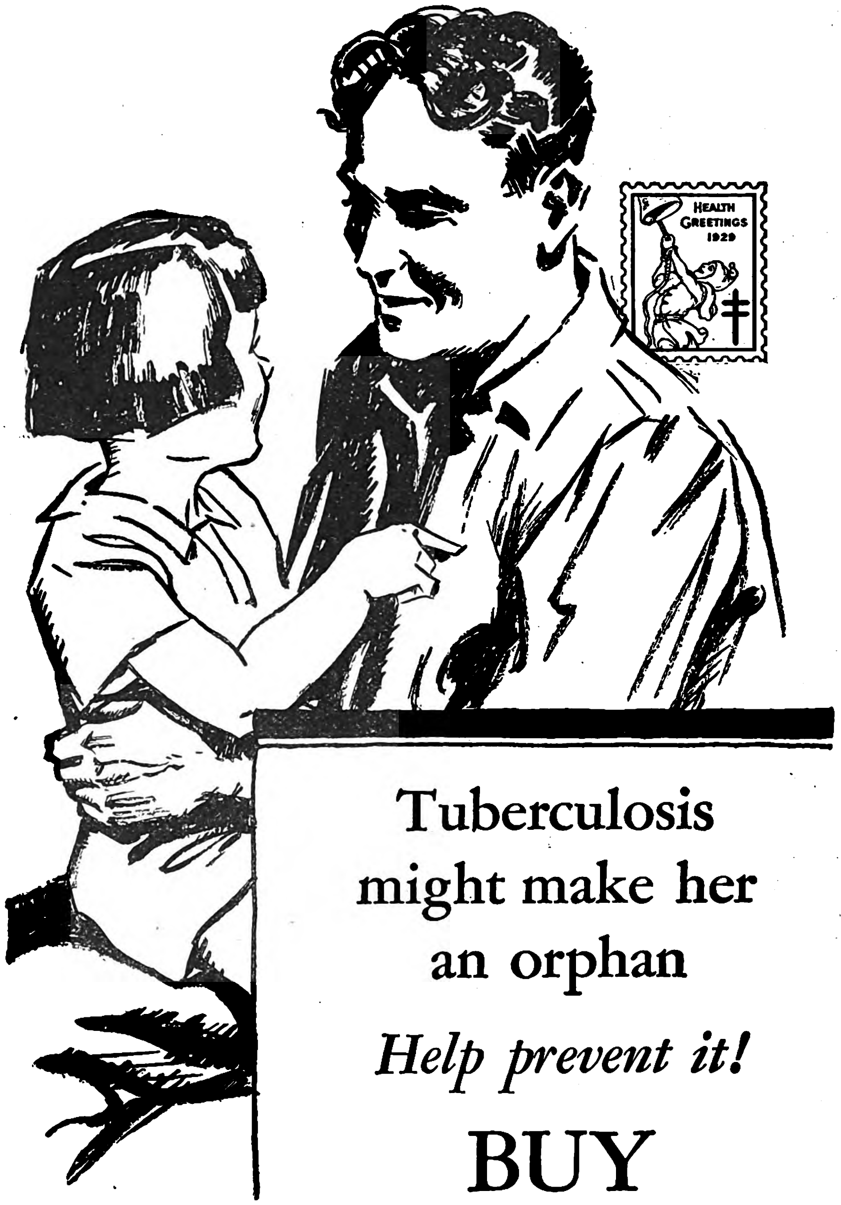
The crowning technical achievement; a combination of all these elements will give us an overnight service from coast to coast.

Improvement in production methods both of plane and engine, greater skill in operation, a far greater intensity of air traffic and hence more intense utilization of material will all reduce the cost of air travel until it is but little greater than that of the best railroad travel.

Since the airplane causes distances to contract, systems covering a geographic area equal to, for example, that of the Pennsylvania Railroad, will appear small. The trend toward mergers and consolidations so strong in all branches of American business is already visible in aviation, as indicated by the formation of such huge concerns as Curtiss-Wright, United Aircraft & Transport, and Aviation Corporation. In air transport this trend is logical, good economics, and good engineering. Therefore, in a comparatively short time we shall witness the consolidation of the airways of the country in a few huge and powerful systems.

Air travel will become within 10 years well nigh universal.

THE END



Tuberculosis might make her an orphan

Help prevent it!

BUY CHRISTMAS SEALS

The National, State, and Local Tuberculosis Associations of the United States

Our Choice of Recent Books

Modern Aviation Engines

By Victor Pagé

FORTY-SIX chapters describe the various leading American, English, French, German, and Italian aeronautical engines, considering thermo-dynamics, design, construction, repair, and trouble shooting. Diagrams and charts are especially clear and understandable and materials of construction, alloys, et cetera, are thoroughly covered. The most complete and up-to-date work that has yet appeared. Volume I includes general applications; Volume II describes individual motors, et cetera. Separately $5.00 per volume. Both volumes, $9.00 postpaid

Mechanics of the Gyroscope

By R. F. Deimel, Asso. Prof. Mechanics
Stevens Inst.

IN reality a text on the dynamics of rotation, this extended consideration embraces the gyro-compass and stabilizers. It presupposes a knowledge of the mechanics given in college physics although the subject is started at its beginning. There has been need for a work of this kind which covers the entire subject in a most complete and conclusive manner. $4.20 postpaid

Beginnings of Telephony

By Frederick L. Rhodes

AN authoritative discussion of the problems surrounding the beginnings of telephony. Of special interest to inventors, lawyers, and students of our patent system as covering one of the great legal controversies which was definitely and finally adjudicated. The group of telephone cases was characterized by Mr. Justice Brewer as the most important litigation that has arisen under our patent system. $4.50 postpaid

Edison
His Life and Inventions

By Dyer, Martin and Meadowcroft

MOST happily timed to appear when all the world is celebrating the birth of the incandescent lamp, this biography which in considerable part is also an autobiography will be of particular interest as being personally authorized, the third editor being Mr. Edison's secretary for many years. Rich sources of original matter have been drawn upon and the complete work makes most fascinating reading, while the historical importance of such a record will be unquestioned. Generously illustrated with reproductions of unique photographs.

Two volumes—$10.00 postpaid

Scotland Yard

By J. F. Moylan

WHAT Scotland Yard is and does, how the police work and live, the duties of uniformed and plain clothes men, the development of the detective force and the scope and methods of criminal investigation are fully described by one possessed of all the facts, yet the story is divested of statistics, being written for the general reader. An interesting resume of a famous organization. $2.65 postpaid

Sparking of Steel

By E. Pitois
John D. Gatar

FACTS which everybody using steel should know. The illustrations present a complete practical series of spark streams and the contingent description is clear and concise, in understandable terms. A most valuable and interesting presentation of excellent format. $2.15 postpaid

Drury's History of France

By Franklin Jameson
Mabell S. C. Smith

ONE of the well thumbed books in our library, for besides being the most authoritative, periods are presented in a style that is entirely removed from that of the textbook, and the grouping is one that carries on with a sequence like a story. This fourth edition continuing to the year 1929 will be welcomed in every library. It is interesting to note that reference to French history seems more often required than to any other history. $3.90 postpaid

Principles of Economics

By F. S. Deibler, Prof. Economics, Northwestern Univ.

Price incorrectly quoted last month. Correct price is $3.20 postpaid.

The Most Nearly Perfect Food

S. J. Crumbine
J. A. Tobey

YOU will be surprised to find that you know so little about the production, practical sanitation, and dietary functions of milk and its products. From the intriguing frontispiece to the last chapter "How the world gets its milk" you will find much that is interesting and profitable and all is told from a practical standpoint that will appeal to every consumer. As interesting a little volume as we have seen in many days. $2.65 postpaid

Ends of the Earth

By Roy Chapman Andrews

THE story of the wanderings of this scientist explorer who has revealed, among other significant accomplishments, a new volume in the history of the earth. From a boy working his way through school doing taxidermy, to the leader of the large expedition into the Gobi Desert, the story grips one with its fascinating interest and importance. Sprightly told and abundantly illustrated. $4.65 postpaid

Albert—King of the Belgians

By Evelyn Graham

THIS authorized biography of the most outstanding monarch of the war reveals intimately a character so heroic and so inspiring as to receive the unqualified admiration of the world. Wherever the subject touches other countries, new information of importance is added to that already available. One of the most interesting biographies we have read. $5.20 postpaid

The Prince of Wales

By W. R. L. Townsend

THE biography of this most popular Prince told in an informal way that describes his likes and dislikes, his duties, amusements, accomplishments, and friendships. Many entertaining stories are told that show how keen he is and how he loves his people, with glimpses of the private life of the royal family. Through it all one sees the development of a personality and a character that is thoroughly likeable. $2.65 postpaid

Foch
My Conversations with the Marshal

By Raymond Recouly

CLOSE comradeship up to the time of his death afforded the author unexcelled opportunity to record faithfully Marshal Foch's estimates of the men who fought against him, the Allied and political leaders, and his thoughts on the conduct of the War in general. As important as it is intimate and authoritative. Some of the opinions recorded are startling. $3.20 postpaid

Bolivar
The Passionate Warrior

By T. R. Ybarra

A LINEAL descendent of a participant in the story of liberation which is described, the author had access to original material that adds greatly to previously recorded facts, and weaves a fascinating tale of adventure and patriotism comparable to the best historical fiction. A good subject, well written, and founded on long and careful research. $4.20 postpaid

Twelve Royal Ladies

By Sidney Dark

ANOTHER title might almost have been chosen for this book—"Unhappy she who wears the crown," for ten of the subjects of these sketches never realized even average happiness. The author weaves an insight into the times while describing the characters in a style which is most readable and carries attentive consideration. $3.15 postpaid

The Human Side of Science

By Grove Wilson

WE have had science presented to us from many angles but this work quite strikingly emphasizes the truth that it is something warmly alive; the truly great scientist having a definite kinship with the artist and poet. Ten years of research adds to the value of the interpretations of the great lives which are here sketched with appreciative understanding and the whole tone of the work is most elevating and inspiring. $4.20 postpaid

The Wonderful Story of Science

By Inez N. McFee

SEVEN of the major sciences are viewed in a manner that points out the scope and most important facts of each, giving to the interested seeker a thirst for more extended study; each chapter may be considered as an introduction to the particular science it represents. An ambitious but quite successful treatment. $2.65 postpaid

The Universe Around Us

By Sir James Jeans, Cambridge University

THIS new book, we predict, is destined to have as phenomenal and as deserved a sale among scientific thinkers both lay and professional as the equally brilliant, outstanding work of Eddington, "The Nature of the Physical World," has just enjoyed. If this prediction is fulfilled Jeans' book will become the outstanding scientific book of the coming season. Sir James Jeans is unquestionably one of Great Britain's three most famous and ablest cosmological thinkers. Fortunately he can and does write, not only so the average man can well understand him, but it has been commented again and again by other scientists that everything he writes seems to take on an enhanced fascination due to his own enviable manner of presentation. The present book has six parts: Exploring the Sky; Exploring the Atom; Exploring in Time; Carving out the Universe; Stars; Beginnings and Endings. Thus its scope is as broad as the universe, extending from microcosm to macrocosm. This philosophical work will stir profound thought in the reader who likes to think. Size 6 x 9; 331 text pages; 24 plates; clear type; good paper and binding. $4.70 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Reward Awaits Inventor of Machine

ALTHOUGH a reward of 25,000 dollars was offered as early as 1869 by the Government of British India for the invention of a machine that would separate the fibers from the stalk of the Ramie plant, the required machine has not yet been invented. Ramie is cultivated commercially in China and Japan, and might prove a desirable crop for the southern United States, according to the Department of Agriculture. The development of such an industry is awaiting the invention of a decorticating machine which will strip the fibers from the plant more economically than by the hand methods used in the Orient.

Ramie is a perennial shrub and belongs to the nettle family, but does not have stinging hairs. The fibers develop in the inner bark, and are removed by stripping the bark from the stalk, after which the fibers are scraped out by hand. The process corresponds to the scutching of hemp, but is essentially different. The fiber is remarkably strong, according to Mr. Lyster H. Dewey of the Bureau of Plant Industry, and it is adapted to many uses although it is not readily spun on spinning machinery designed for other fibers. Experimental plantings have shown that the crop would be well suited to the lowlands of the southern states. It grows in a warm, temperate climate with abundant rainfall and requires very fertile, well-drained soil.

Mr. Dewey has written a brief summary of the information available in regard to the plant, which has been published as Miscellaneous Circular 110-M, entitled "Ramie, a Fiber-Yielding Plant." This circular is available for free distribution to those who apply to the Department of Agriculture, Washington, D. C.

No Infringement in Old Process for Cleaning Neon Tubes

IN ruling that the defendant's process for removal of impurities from neon tubes before the introduction of the neon did not constitute an infringement of the process covered by patents held by Rainbow Light, Inc., the District Court for the Southern District of New York held that the process used by Claude Neon Lights, Inc., was in use long prior to the issue of the plaintiff's patent in 1925. Witnesses for the defendant testified that the process used by the Claude company had been practiced in 1923 and 1924.

The patent in question (Number 1618767) covers a process of purifying neon tubes by introducing a purging agent such as an alkali metal, causing it to co-act with the walls of the tube or with the impurities therein, subsequently evacuating the tube, and then introducing the neon. The process of the defendant, which was claimed to be an infringement, consists in evacuating sufficient air from the tube to permit an electrical discharge through it, and then causing the discharge to take place until the wall of the tube is heated almost to the melting point, after which the tube is completely evacuated. No alkali metal is put into the chamber of the tube by any separate step such as the distillation or electrolyzation mentioned in the patent. The plaintiff contended that in heating the tube, some of the sodium is liberated from the glass and vaporized, and that it bombards the wall of the tube as described in the patent.

Although many scientific questions were raised at the trial, they were considered irrelevant to the case. Judge Coleman based his decision on the testimony of experts and the testimony of defendant's witnesses, the latter declaring that the process of the Claude company has been used in manufacturing neon tubes since 1923, or two years before patent was issued.

Patent Protection Still Effective

CRITICS of our system of patent protection have made many disparaging statements which seem to contain more breadth than depth. We are pleased to present an authoritative contribution from T. Hart Anderson, member of the New York Bar, which refutes certain unjustified criticism and shows that inventors may still sue all infringers excepting those furnishing infringing devices to the Government, and in such cases one may sue the Government. Judge Anderson's contribution follows:

During a recent conference with a client, an engineer, he advanced the theory that it was of no further use to patent inventions because one could no longer get protection under patent rights; that one could no longer sue the infringer. As a basis for this statement he called attention to a recent issue of *Engineers and Engineering* in which appeared an account of an address by Mr. Chester W. Cuthell of the American Bar Association, delivered at a meeting in Philadelphia held under the auspices of the Engineers' Club, the Aero Club of Philadelphia, the American Society of Mechanical Engineers, and the Philadelphia Chamber of Commerce.

What appears to be substantial foundation for the impression received by this engineer as to the ineffectiveness of patents is found in Mr. Cuthell's statement to the effect that, "The patentee couldn't even sue, and he can't today sue, the manufacturer, the outside manufacturer, who never invented anything, but who has used the invention supposedly covered by a Government patent."

The particular law to which the learned author takes exception is that which requires that suits for patent infringement be brought against the United States Government, and not against the manufacturer or contractor who makes for or furnishes to the Government anything which infringes a patent. This law provides that such suits shall be brought in the Court of Claims. Mr. Cuthell asserts that this law is a war measure and should be "stricken down just as promptly as all other war measures should be stricken down." He particularly emphasizes the alleged bad effects of such a law as it concerns the aviation industry.

He states that Wright "has been out of invention for a great many years" and that Curtiss "has been running a farm in Florida." While deploring the loss to this industry of these two great figures, he attributes it to this law. It is further asserted that this law has interfered seriously with the financing of many inventions in the aviation business. Just what foundation he has for asserting that Wright and Curtiss are no longer interested in aviation inventions is not known. However, where they left off (if they have left off as stated by the learned author) thousands of other inventors are carrying on, making valuable improvements and inventions of importance to aviation, for which they are seeking and obtaining patents as usual.

When one appraises the remarkable progress of the aviation industry, and particularly of those companies engaged in producing airplanes and aeronautical equipment, it is hard to believe that this alleged objectionable law has had any effect whatsoever upon the financing of inventions or upon the industry as a whole. In a recent financial-statement issued by a leading firm of investment bankers, it is stated that "the United States not only has more airplanes in operation than any other country in the world, but the 1928 American production was greater than that of all the rest of the world combined." They further state that the production of airplanes increased more than 300 percent last year; that approximately 4500 airplanes and 3500 engines with a total value of 75,000,000 dollars were produced, and that the production of airplanes for the current year is estimated at 10,000 or 12,000.

This hardly looks as though the aviation industry has suffered because of this provision of the law, but still the learned author insists that it is unfair to inventors, for in the *New York State Bar Association Bulletin*, for September, there is a report of another address by Mr. Cuthell, delivered at the annual meeting of the New York State Bar Association. In this address he has this to say:

"The Federal law as to use by the Government of patents is very unfair to inventors. It was passed during the war as a war measure and it should be taken off the books. It prevents the patentee from suing a private infringer if the infringer is manufacturing for the United States Government, and gives the patentee only the right to sue in the Court of Claims for reasonable and entire compensation."

In this address the speaker seems to have discovered that the financial difficulties to which he referred in Philadelphia were nonexistent, because he refers to the fact that "during the past year there has been a tremendous activity on the part of the bankers and lawyers in the financing of aircraft enterprises of all sorts." He also refers to the "activity on the part of the Patent Bar in respect to matters growing out of aviation." This activity of the Patent Bar, of course, negatives the idea that protection under patents can no longer be obtained because of this law.

Apparently Mr. Cuthell dislikes the fact that where the Government is involved one must sue the Government and not the manufacturer of the alleged infringing device, and that one must bring the suit in the Court of Claims. Now a suit in the Court of Claims is no different from a suit in any other Federal court. Anyone can get exactly the same relief so far as compensation is concerned as in any other court. It certainly is much better to sue a responsible government than an irresponsible individual or corporation.

In such a suit the Government can, of course, make the same defenses that any defendant could make, and the owner of the patent must meet such defenses in exactly the same way as he meets them in a suit in any court. The reason for this law, and its only effect, is to save the Government and those making devices for the Government from an injunction which might work to the disadvantage of the nation. Otherwise the owner of a patent in the aviation industry, or any industry, is at no disadvantage whatsoever.

Patents are just as effective as they always have been. It is just as desirable to patent inventions as it ever was, and except in the one instance where the Government is involved in the alleged infringement, the courts are always open to the owner of a patent. Wherever relief and compensation is justified, one may be sure that so far as the courts are concerned it will be extended.

Word Writing Machine Perfected

ONE of those inventions which startle even the most severe critic into a confession of amazement and admiration has been perfected and patented by Mr. Clyde C. Balston. His invention is a typewriting machine for use in offices, which prints words and phrases with about ten times the speed of a typewriter. It is designed for use in large offices, and does billing as well as writing of all kinds. The machine is about one and one half times the size of the customary typewriter, operated electrically and can be operated as a regular typewriter as well as a word and phrase writer. Its keyboard is a novel but not complicated departure from the keyboard of the typewriter; in addition to the "standard" arrangement of the keys, there are several auxiliary banks of keys which correspond to an ingenious chart containing the words and phrases which constitute about 99 percent of our usual vocabulary.

Mr. Balston has discarded the idea that every word we write must be decomposed into the individual letters by the typist, and then mechanically put back together again by the machine on the paper. As shorthand writers learned long ago when word signs first came into use, the single unit system is grossly inefficient. Instead of depending on the typist's artistic display of brain-and-finger gymnastics, the word writer attends to the composition automatically by means of an intricate assembly of rapidly revolving disks and combs inside the machine.

At the touch of two keys, one representing the initial letter of the word and the other a selector, the desired word is instantly and automatically impressed on the paper with the proper spacing and punctuation. Conventional phrases used over and over again in business correspondence are written in the same way—by pressing just two keys.

Misplaced Copyright Notice Void

NO protection was gained by placing the notice of copyright in all copies of a booklet on the last page, according to a recent decision of the District Court for the Eastern District of New York in a suit brought by United Thrift Plan, Incorporated, against National Thrift Plan, Incorporated. The misplaced notice was held not to constitute compliance with section 19 of the 1909 copyright act, requiring that notice of copyright be placed on the title page or the next page. To be relieved by the law, a plaintiff must have sought to comply with the law, and in this case it was held that the plaintiff had knowingly neglected to follow the plainly stated terms of the statute.

The case was dismissed, but no counsel costs were awarded the defendent. The plaintiff contended that its rights were infringed, citing the fact that the defendant had published a booklet containing matter copied from the last page of the booklet bearing the misplaced copyright notice, and that the defendant must have known that the book was copyrighted. The court ruled that this contention could not be sustained no matter how strong might be the suspicion of its truth.

Section 19 of the present copyright act provides where the notice of copyright shall be placed, as follows:

". . . one notice in each volume or number of newspaper or periodical. The notice of copyright shall be applied, in the case of a book or other printed publication, upon its title page or the page immediately

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AIRPLANE STABILIZER—Whereby means are provided for the shifting of ballast and manipulating the wings for stabilizing the plane while in flight should the equilibrium be disturbed by any of the influences to which such apparatus is subjected. Patent 1727275. Federico G. Diago.

AIRPLANE CONSTRUCTION—A unit comprising a Venturi tube, a propeller just in advance of, and extending a trifle beyond the rim of the tube, and a second propeller disposed inside of the rear of the tube, and rotated in an opposite direction to the first propeller for propelling an airplane. Patent 1727542. Albert C. Gienger.

WATER DRAWING APPARATUS FOR AIRCRAFT—Which permits water to be drawn into the aircraft while the latter is in motion, the device will not interfere with the landing gear, being movable by pneumatically controlled mechanism from operative to inoperative position. Patent 1729558. Vincent Strafino.

Pertaining to Apparel

SHOE-BUCKLE HOLDER—Constructed from a single sheet of resilient material, which may be readily secured to the upper edge of the shoe vamp so that a buckle may be detachably connected and rigidly maintained in applied position. Patent 1727650. Fred F. Kohn.

CORSET—Having novel means for concealing the adjustment portions in order that the outer part of the corset may be relatively smooth, and obviate the adjustments showing through the outer garments. Patent 1728985. Earle B. and Amy Stewart.

Chemical Processes

METHOD OF CARBONIZING A CELLULOSE-CONTAINING SUBSTANCE SUCH AS WOOD, PEAT, AND THE LIKE—Consisting in thoroughly soaking the said materials with a concentrated solution of calcium-chloride, adding thereto a small amount of hydro-chloric acid and heating the mixture at a pressure of less than fifteen atmospheres until said cellulose-containing material is carbonized. Patent 1728807. Carl G. Schwalbe.

TREATMENT OF FELT AND FELT-HAT BODIES—For increasing the lustre, by placing the hat bodies into an aqueous solution of a complex compound of a heavy metal, at a temperature below boiling point, for some time under slow agitation. Patent 1729474. Erich Bohm.

Designs

DESIGN FOR A RADIATOR-CAP ORNAMENT—Patent 79333. Biagio Intingaro.

DESIGN FOR A MIRROR OR SIMILAR ARTICLE—Patent 79394. Rose Statella.

DESIGN FOR A VANITY CASE—Patent 79421. Leonard Friedberg.

DESIGN FOR A STATUETTE—Patent 79515. Mildred C. Gresham.

Electrical Devices

ELECTRIC MOTOR—Of the solenoid type, whereby a relatively high torque and speed of the revolving elements or armature may be obtained, adapted to operate from either alternating or direct current. Patent 1728054. Alexandre F. Godefroy.

STATIC ELIMINATOR FOR RADIO RECEIVERS—Which intercepts undesirable electrical impulses before they reach the receiving apparatus, by means of an air gap whereby such impulses may escape, and a sounding metallic screen upon which said impulses may impinge before being grounded. Patent 1728057. Watson E. Grimm.

ELECTRIC LIQUID HEATER—For heating water or other liquids, the principal object being to so arrange the bottom terminals that short circuiting by virtue of an accumulation of sediment will not occur under ordinary circumstances. Patent 1729587. Barnett W. Macy.

Of Interest to Farmers

STANCHION HALTER—For use in holding the heads of cattle rigidly in their head stanchions for performing any necessary operation thereon, such as de-horning, permitting the operation to be performed in the animal's stall. Patent 1727290. George A. Jones.

following, or if a periodical either upon the title page or upon the first page of text of each separate number or under the title heading, or if a musical work either upon its title page or the first page of music." Copyright is secured by publication of the work with the notice of copyright required by the act.

Copyright for Photographs

RECENT changes in the regulations governing copyrights have increased the cost of copyrighting a photograph. The charge is now one dollar when no certificate is desired, and two dollars when a certificate is requested. Using the proper blanks, photographs may be made and prints sold the same day with complete copyright protection, if the blank is filled out and immediately mailed with two copies of the photograph and the one dollar fee. If one wishes to have a minimum amount of lettering appear on the face of the print, one may use the letter C within a circle followed by the initials or monogram of the photographer. When this is done, "Copyrighted by" and the full name of the photographer must appear on the back of the photograph.

If the above form is not used, the words "Copyrighted by" and the full name of the photographer must appear on the face of the print within the picture area. If pictures are produced and sold without the copyright notice they cannot be protected by a later application for copyright. Every print made from a copyrighted negative must bear the copyright notice. For this reason it is best to place the copyright on the negative itself.

Any person who contemplates copyrighting photographs should procure application blanks and complete information from the Registrar of Copyrights, Library of Congress, Washington, D. C.

Method Patented for Improving Celery

GOING beyond the prior art, which disclosed a method of treating citrus fruits for the purpose of changing the color of the skins, a method has been patented which improves the edibility of the product, which in this case is celery. The new method of treating celery consists in applying unsaturated hydrocarbon gas mixed with air, rendering the celery less bitter, less stringy, and more edible, as well as changing the color.

The claim rejected by the examiner and later allowed by the Board of Appeals of the Patent Office reads as follows: "A method of treating leafy green vegetables to remove acrid bitter green substances, which consists in exposing the vegetables to the action of ethylene, admixed with air in proportions ranging from one part of the gas to one hundred thousand parts of air to one part of gas to one hundred parts of air."

The patent was issued to Rodney B. Harvey. In commenting on the older Denny patent for coloring the skins of citrus fruits, the opinion states that the prior art process did not solve the appellant's problem of making the product more edible.

"There was nothing in the Denny treatment," according to the decision of the Board of Appeals, "that would teach or suggest that the same method could be employed to convert a bitter substance contained in the edible portion of the vegetable to sugar. We believe that even if it occurred to anyone to blanch out the green appearance of celery, he would expect no more than the change in appearance, and that the sweetening and reduction in stringiness would be a surprise and therefore an unobvious result. We therefore consider that the teachings of Denny do not constitute anticipation of the claims of this application."

COMBINED ROD AND GUN—Especially for spraying, so formed that it may be used under low shrubbery, or for fruit trees at a height of six feet or more, directing a stream not injurious to blossoms, fruit or leaves. Patent 1728455. Ernest C. Taylor and David B. Mackie.

Of General Interest

CIGARETTE-MAKING APPARATUS—A readily manipulable apparatus which is portable and adapted to be used by any smoker for making a single cigarette with ease, or may be used for the manufacture of cigarettes commercially. Patent 1726368. George P. Silke.

DISPENSING VALVE—Which embodies novel features of construction rendering it practically leak-proof, reliable and effectual in operation, particularly adapted for discharging quantities of liquid soap. Patent 1726402. Winfred N. Lurcott.

BUILDING CONSTRUCTION—Consisting of a steel framework so formed that it may be readily assembled in the field without the use of rivets, designed for relatively light work, such as private homes, small buildings, garages, etc. Patent 1726400. Henry B. Littlefield.

PROCESS OF MAKING A WASHING LIQUID—Which comprises a mixture of sodium carbonate, pulverized lime stone, and calcium chloride, will remove grease and other foreign matter from fabrics without injury to the article, may be used in combination with ordinary washing soaps. Patent 1728082. Eugene Scales.

HAIR-WAVING DEVICE—Designed to conform to the head of the user and so constructed that when a number of them are engaged with the hair side by side, uniform and continuous waves will be formed. Patent 1727218. Alexander J. Rusak.

FOLDING ARM-CHAIR—Which may be folded or set up by a simple relative movement of the seat with respect to the back, which may be accomplished with one hand only, accidental collapsing is prevented. Patent 1727255. Finn Simmons.

TIE RACK—Formed of a single strip of metal horizontally disposed to receive ties, a plurality of points to prevent slippage of the ties, and a bracket for securing the supporting means to a wall or fixed support. Patent 1727269. Robert L. Bee.

CAPS FOR CONTAINERS—Having threaded discharge necks, wherein the cap may be readily screwed into place or removed, and may be moved to an open position without being disconnected by means of a swinging structure. Patent 1726966. Fred and Walter Schlayer.

STRUCTURAL-STEEL FRAMEWORK—A supplemental column for partially supporting the gravity load to relieve the main columns thereof, and to lend to said main columns a greater wind stress capacity than could otherwise be sustained on a given area, allowing a building to be erected to greater height than heretofore possible. Patent 1726844. John A. Larkin.

ASPHALT PAVING COMPOSITION—Which incorporates asphaltum in impalpable powders to produce synthetic rock asphalt having all the desirable properties of natural bituminous rock asphalt capable of being shipped in granular state without forming a mass. Patent 1727231. James S. Downard.

JOINT FOR STRUCTURAL-STEEL COLUMNS AND GIRDERS—Including integral wing gussets projecting in different planes which permit direct attachment of the girders to the column, thereby eliminating connections by angles and hence placing all rivets in shear which establish such connection. Patent 1727293. John A. Larkin.

METHOD FOR PHOTOGRAPHING OBJECTS—Which permits the making of photographic reproductions either in exact, reduced, or enlarged size, without focusing in the usual manner, by means of a compass with identical scales corresponding with graduated readings on movable parts of the camera. Patent 1727288. Carl G. Johnson.

New Insulating Material Patented

AN electrical insulating material composed of the fiber obtained from certain portions of the leaves of the Bromelia family has been patented by Harold H. Brown (Patent Number 1725335), who is credited with having been the first person to discover that the fibers have superior and unexpected electric insulating properties. The claims were allowed although a prior description was found of paper made of such fibers being used for insulating purposes, but it was shown that previous investigators had only contemplated the use of the material for making a "strong wrapping paper and a heat-insulating paper for use in refrigeration chambers or private houses."

All of the claims had been rejected by the examiner, but the Board of Appeals reversed his decision. An affidavit from the vice president of the Western Electric Company was submitted by the applicant, in which it was stated that paper represented to have been made from the fiber of the plant "caroa" and supplied by Mr. Brown was tested and proved efficient as an insulating material and better than most of the insulating materials commonly used for wrapping wires in telephone cables. It was also stated that the material was first brought to their attention by Mr. Brown, and that the company had entered into a contract and paid him a substantial sum for the right to use it.

Trademark for Grapes Held Invalid

REFUSING to restrain other dealers from using the name "Lady Finger" for a variety of grapes, although the owner of a trademark covering the name had sought an injunction, the Ninth Circuit Court of Appeals decided that the name "Lady Finger" is not a valid trademark but is the name of a variety of grapes. The court pointed out that there was no effort on the part of the defendants to simulate the plaintiff's labels or to in any way indicate that the grapes were produced or packed or marketed by the holder of the trademark, other than by the use of the name "Lady Finger" indicating the variety of the grape contained in the package.

The case was brought by A. B. Humphrey Company against Ben H. Arkelian and others, on appeal from the District Court for the Nothern District of California. The law of the State of California stipulates that boxes containing grapes must be marked with the name of the variety, and designates one of the varieties as "Lady Finger." The higher court ruled that the defendants were entitled, if not required, to use the name in designating the variety of the grape packed and shipped by them. The appellant's plea for relief by injunction was denied, in view of the opinion that the name "Lady Finger" was not valid for trademark use, although registered.

Ice Cream Container—Which maintains the ice cream frozen and yet entirely isolates the ice and salt from the ice cream and from the opening through which access is had to the ice cream. Patent 1726469. Charles M. Brenner.

Pencil Sheath—A sheath which is adapted to be positioned within a garment pocket for the reception of a pencil, whereby to prevent casual displacement or loss and to protect the point against breakage. Patent 1728128. Nobyoshi H. Kodama.

Bath Spray Apparatus—A shower bath spray attachment which is adjustable vertically to suit the convenience of the person using the same, and is arranged to be detachably supported from a shower bath curtain. Patent 1728129. Harry Madison.

Control Device for Stoves—Which serves the purpose of automatically shutting off the supply of gas to the burner of the stove, by the overflow of any liquid, such as coffee, tea or water being boiled on the stove. Patent 1728107. Charles F. Conover.

Loose-Leaf Book—Having leaf-holding means which serve advantageously for pocket size books with flexible covers, and will not make the book bulky at the back, the construction is simple and inexpensive to manufacture. Patent 1728078. Antti Polkko.

Cake and Pie Tin—Of substantially conventional construction but having associated therewith a specially constructed cutter or knife for readily separating the pie or cake from the container, while at the same time presenting means which form a handle. Patent 1728087. Clyde W. Stuart.

Price-Ticket Holder—Having movable spring actuated cooperating parts so constructed as to hold an indicia bearing card in such manner that it may be readily gripped for the purpose of removal from the holder. Patent 1728789. Francis Devins.

Interlocking Joint for Steel Construction—Which enables all parts in connection with building frame structures to be interlocked and securely welded so that the structure becomes integral without the use of rivets, thus doing away with noise. Patent 1728782. Charles Carmichael.

Retaining Device—For adjustably and detachably holding, and for forming a brace between relatively movable parts of an article, such as a folding chair, or other articles to be held in different adjusted positions. Patent 1728849. Arthur F. Bailly.

Roof—Which includes a waterproof base and a mastic which will substantially fill the interspace between slates, thereby eliminating the necessity for overlapping the slates, yet the roof will be entirely waterproof. Patent 1728795. James H. Griffin.

Fishhook Disgorger—Which may be easily operated, and is so constructed that after being released the point of the hook is protected to prevent its re-engagement during its withdrawal from the mouth of the fish. Patent 1728864. Henry A. Kramer.

Bottle Opener—Which may be used either for removing bottle caps, or withdrawing corks, being so constructed that the insertion of the corkscrew will operate to exert a pulling action to automatically withdraw the cork. Patent 1728787. Joe de Bracht.

Submarine Rescue Device—For persons confined in a submarine which has been sunk and cannot of itself rise to the surface, an attachment being provided which will present by a signal at the surface the location of the submarine, whereby communication may be readily provided for releasing the persons, or supplying air, without an appreciable amount of water entering the submarine. The inventor has been granted two patents, 1728808 and 1728882. Yoshi Shimizu.

Watch-Holding Attachment for Belts—A belt having a novel type of clip for anchoring the end of a pocket watch chain, either to the belt or to the strap of a wrist watch, which may be mounted on the belt. Patent 1729578. Frank Gogan.

Process of Artificially Aging Tobacco—Which includes the steps of steaming the tobacco with a cereal grass extract, then packing and sweating the tobacco, then again moistening the tobacco with the extract and re-packing and re-sweating. Patent 1729482. Thomas H. Keller.

Article Rest—For fragile articles such as bottles, particularly nursing bottles, whereby a baby may feed from the bottle in reclining position, without the employment of other means of support and without liability of accidental displacement. Patent 1729531. Charles N. Wolever.

Hotel Room Service-Table—For serving meals in the private rooms of hotels, the table being constructed to include a heating cabinet to permit the complete transportation and service of an entire meal by a single waiter at one trip. Patent 1729491. Frank Rygl.

Resting Device—Whereby the head or other portions of the body may be comfortably supported for a period of time, as in hair curling where heavy electrodes are attached, to the head, thus eliminating fatigue during the operation. Patent 1727751. Frances M. Davenport.

Float Valve—Of simple construction, and not easily liable to get out of order, for use in conjunction with water flush tanks for controlling the filling of the tank. Patent 1729484. Francis E. Lee.

Exerciser—In which the resistance may be varied according to the physical condition of the person using it, the hand grips being so arranged as to permit the change of elastic elements of various thicknesses. Patent 1729399. Roy H. Noe.

Fastener—Having a head adapted to be inserted through a slot, eyelet, or other opening, and then turned to transverse the opening, may be constructed as a curtain fastener, or in a collar button type. Patent 1729489. Frederick C. Rile.

Flush Lever—Having a stem and adjustable collar which make it readily possible to adjust the height to which the flush ball may be lifted without rebending the lift wire, particularly adapted for closet tanks. Patent 1729546. Herbert B. Myers.

Hardware and Tools

Device for Picking Fruit—A light-weight tool having a blade and a dependent finger-receiving portion so that the fruit can be cut without disturbing the rest of the hand which may be engaged in holding a fruit container. Patent 1727286. Allie H. Hamre.

Welding Tongs—A tong particularly adapted for use in electric welding, characterized by the ease of manipulation and the ability to firmly grip electrodes of different sizes or release them at will thereby facilitating welding operations. Patent 1726624. Ernest S. Lawson.

Cutting Instrument—A double acting multiple instrument adapted to simultaneously operate in opposite directions a plurality of tools such as saws or choppers, particularly adapted for use by butchers. Patent 1726863. Samuel Singer.

Auxiliary Link—Composed of two identical U-shaped parts that may be removably secured together without any fastening devices being necessary, and will bind together more tightly as greater tension is applied. Patent 1726654. Knut A. and Klause E. Dahlgren.

Shredder—A kitchen tool formed of noncorrosive or rustproof material and capable of being used for shredding edibles, such as pineapples, the knives being readily adapted for cutting the meat of the fruit into shreds. Patent 1728801. Margare M. McCutcheon.

Lifter for Stone Blocks and the Like—A heavy metal tool which may be quickly applied and removed and will securely engage the block, and cannot be released until the stone engaging elbow is unscrewed. Patent 1729467. William S. Whyte.

Joint Re-enforcement for Metal Doors or the Like—A wrought metal re-enforcing block for the joints of hollow metal doors, including a pair of plate members flanged on two sides and secured together with the flanges overlapping and the plates spaced apart. Patent 1729586. Louis Liebman.

Casing Spear—Which is capable of being operated from the top of a well to grip a casing at any point so that the casing may be pulled from the hole, or the sections unscrewed or screwed together. Patent 1728136. Edward D. Power.

Heating and Lighting

Sectional Boiler Header—An air-tight joint or seal between the contacting faces of boiler header sections whereby the passage of air between the header sections is obviated, particularly adapted for steam boilers. Patent 1729487. Edwin C. Ramage, Jr.

Machines and Mechanical Devices

Sawmill—Making use of but one engine, it does not move the log against the saw, but advances the saw against the log, thus eliminating waste motion, is readily transportable and adapted for sawing railroad ties. Patent 1725295. Rober H. Orr.

Flexible Mechanical Power Transmission—Primarily intended as a gear for transmitting, without lag, the power generated by a constant torque prime mover, such as a steam turbine or internal combustion engine, driving machine tools and pointing guns. Patent 1727232. Stephen A. Farrell.

Water-Lifting Apparatus—Which will not only be mechanically efficient, but will be simple, of practical construction, rugged and durable, suited to the requirements of economical installation and inexpensive to operate in elevating water. Patent 1727216. Thomas J. Porter.

Display Device—In which the exposed matter is continuously changing, the driving mechanism simple positive and smooth in operation, and the displays brought into view each being removable. Patent 1726605. James S. Anderson.

Valve Grinder—Which may be tilted at any angle from the vertical during the operation of grinding the valve, an adjusting plate is resiliently supported at one end of a rotatable barrel for carrying a valve wrench. Patent 1727292. Joseph R. Keiper.

Tension Device for Spinning Machines—An attachment, to co-act with upper delivery rollers whereby the core yarn is maintained under positive tension as it is advanced between the usual rollers of the machine, with the roving strand. Patent 1728066. Giles A. Lay.

Pump Valve—Characterized by its ability to seal itself in closed position against possible leakage through the port which it controls, particularly adapted for slush pumps as used in drilling oil wells. Patent 1725297. John L. Paterson.

Automatic Coat-Hanger Making Machine—Which will take the rough wood, chip the ends, bevel the top, for providing a smooth garment-supporting surface, drill an opening in the center, insert a wire, bend a hook, and discharge the complete hanger. Patent 1727513. Earl B. Maloon.

Printing-Press Feeder—Having means which allows envelopes to be stacked flap downwards, and to be individually advanced into printing position, and a pushing element which separates the envelopes after the printing operation is completed. Patent 1724199. James W. Hoag.

Garment Counter—Particularly adapted for stockings, wherein counting mechanism is automatically operated as the garments are placed in a holder which is automatically closed when a predetermined number have been placed therein. Patent 1729497. John K. Voehringer, Jr. and Robert A. Gibbs, Jr.

Bacon Slicer—An adjustable slicing machine wherein bacon or other meat may be supported and fed either horizontally or upwardly on an incline to a cutting knife which functions regardless of the angle of the bacon. Patent 1728843. Max Trunz.

Separator—For separating solid particles from a moving gas stream, comprising a hollow casing of V-shaped cross section, and separated V-shaped partitions through which the gas moves, and means for continuously flushing the centers with a liquid. Patent 1728877. Albert R. Mumford.

Ladder—For use in connection with fire fighting apparatus, which is automatically actuated and vertically adjusted to height by means of a pressure responsive mechanism, and sustained at any desired angle about two right angularly disposed axes. Patent 1728854. Melvin K. Carr.

Tape-Feeding Machine—A tape feeding and moistening machine in which novel means is actuated for automatically cutting off the tape when the tape feeding means is manually released. Patent 1726883. Rufus M. Brooks.

Finisher—Especially constructed for shoe-polishing machinery, in which a long shaft supports polishing wheels of different shapes, these wheels carrying wax that is kept in a warm condition for use at all times. Patent 1726888. Robert J. Crossman.

Fan Mounting—Arranged in such a manner that the rotation of the fan causes the mounting means and the fan to revolve so that the direction of the air current caused by the fan changes continually. Patent 1726881. Ralph N. Berryman.

Mixer—For grain, having a novel form of casing for thinning out the grain, and causing all the grain to flow from top to bottom, and then to be conveyed back, for repeating the operation. Patent 1728411. Oliver O. Howard.

Cotton Cleaner—Which removes foreign material from cotton either before or after ginning, by mixing air with the cotton in a manner to force out the heavier particles, while collecting the cotton through an independent path. Patent 1729503. Cary S. Cox.

Tension Device for Shuttles—Wherein the shuttle may be quickly threaded either automatically or by hand and maintained in threaded position while remaining under tension, the guiding eyes are formed to be readily removed, and the tension varied. Patent 1729551. John Rush.

Shaft Hanger and Bearing—Including casing sections each fashioned from a single sheet of material with one section having its edges rolled to secure the other in mated relation, whereby the sections will retain ball bearings against axial separation. Patent 1729499. Theodor Anthoni.

Medical and Surgical Devices

Dental Bite Method—Including floating partially submerged, two superimposed "bite forms" in a heated liquid until one form becomes softened to a greater degree than the other, with the inside or core of each form remaining hard. Patent 1728199. Abel O. Eberhart.

Apparatus for Containing or Retaining the Human Body or that of Animals, for Medical, Surgical, and Hygienic Purposes—A flexible retaining article formed of india-rubber bands, perforated with a large number of holes which ensure proper aeration and evaporation, linen protecting and isolating the rubber from the skin. Patent 1729502. Louis M. Clement.

Musical Devices

Bridle Strap for Piano Action—Which is capable of being quickly and securely applied to a piano action without dismembering the latter and is sufficiently strong to minimize breakage and resist the usual effects of such straps. Patent 1727502. Hiram E. Chute.

Vibratile Musical Instrument—Comprising a metallic bar having a vibrating center adapted to be struck, and dead metal adhered to the bar at one end which functions to prevent harmonics and overtones but permits the hum to predominate. Patent 1727238. George E. King.

Valved Brass Instrument—Wherein a valve or series of valves may be used in connection with wind instruments such as cornets or horns, to entirely eliminate distortion of the sound wave in its journey through the tubes. Patent 1729568. Ernest A. Couturier.

Prime Movers and Their Accessories

Motor—Of the multi-cylinder type, which eliminates crank arms, and wherein the piston rods are arranged for operating cams carried by oppositely disposed shafts so that rotary movement is imparted in the downward movement. Patent 17428. (Reissue). Paul Marchetti.

Internal-Combustion Engine — In which means are provided for directing a new charge of gas into a cylinder in such manner as to cause this charge to force the exhaust gases out, without mixing with them. Patent 1728472. Gustave H. Brekke.

Pertaining to Recreation

Golf-Bag Supporting Device—Which has novel means for automatically actuating supporting members when the bag is placed upon the ground, and releasing the supports when the bag is raised, the device may be secured to any size or type of bag. Patent 1727612. George W. Lescher.

Swimming Apparatus—Comprising a floating casing with a propeller which is arranged to receive its rotary movement by the simultaneous action exerted by the hands and feet of the swimmer on two pairs of cranks. Patent 1728103. Rene G. Chaligne.

Toy—By which children may obtain the pleasurable benefits of a teeter, the construction being such that the seat and foot rest may be readily adjusted to accommodate children of different sizes. Patent 1729214. Benjamin Gordon.

Toy Vehicle—Having a removable body associated with the chassis of the vehicle to provide a wagon when in applied position, yet when removed from the latter, is convertible into a sled, providing amusement both summer and winter. Patent 1728587. Daniel L. Aldridge.

Pertaining to Vehicles

Child's Automobile Chair—Which may be maintained in anchored position by the weight of an adult so that the child may be readily attended to directly over the lap of the person, who is relieved of the child's weight. Patent 1723899. Robert C. Sturges.

Light-Ray Protector and Holder—Which will contribute to safety in driving a motor vehicle, by providing a glare shield against the lights of approaching vehicles, and a simple holder for the shield, composed of jointed sections. Patent 1720199. Lon H. Barringer.

Clutch-Pedal Control—Which may be readily attached to the frame of an automobile and adjusted for automatically stopping or checking a clutch pedal in its neutral position, particularly adapted for use on Ford cars. Patent 1720075. George F. H. Hicks.

Tire-Rim Tool—Which can be quickly connected to a rim, and when actuated for collapsing the rim will first spread the ends apart and permit the ends to overlap each other during the remainder of the operation. Patent 1717806. Lisle H. Nicholson.

Automobile Oil Record—In which certain data may be displayed on the instrument board, whereby the operator may be informed as to the time when the oil was last changed and when it should be changed again. Patent 1717848. Ralph E. Maxwell.

Scraping Device for Footwear—In the nature of an attachment capable of being readily applied to an automobile running board in an inconspicuous and unobtructing position, for removing dirt adhering to the footwear, thus preventing soiling the floor covering. Patent 1718428. Frank P. McNulty.

Automobile License-Plate Attachment—Which is applicable to a license plate for indicating the current year, being substituted by a similar one in the new year, in this manner the attachment could be renewed annually instead of the entire license plate. Patent 1720258. Hugh D. Barnett.

Switch for Automobile Signaling Apparatus—Which may be readily attached to the steering column of a car and will enable a driver to indicate to drivers of other cars his intended change of course by a "right" or "left" turn. Patent 1723845. Charles J. Diehl.

Trouble - Light - Mirror System—In the form of a set of adjustable mirrors which may be associated with the headlight of a car in such manner that the light will be transmitted by reflection to any desired point. Patent 1723863. Robert Jeffrey.

Combined License-Plate Holder and Signal—Including a casing in which a license plate is sealed against unauthorized removal, and carrying means for lamps to illuminate the license, the right and left turn signals, and a tail light. Patent 1723463. Henry Brewster.

Road Finder—Adapted for connection with the usual speedometer gearing, for giving a driver traveling a strange road, the "right" and "left" turns, the side streets, condition of the road to be traveled, garages, and hotels, in advance. Patent 1725644. William H. Kirby.

Automobile Signal — Automatically actuated through the movement of the brake or clutch pedal, and including mechanism whereby the pivotal motion of the foot pedal is transformed into relative rotary motion of a signal arm. Patent 1726443. Benedict Mayer.

Direction Indicator—Which is convenient to handle, does not require complicated working mechanism, and may be readily secured to any type of vehicle, indicating direction to other drivers or pedestrians, by means of a pointer and light signals. Patent 1725248. Eugene A. Bradbury and Wilford B. Holland.

Automobile Signal—Compact in form and adapted to be controlled by an electric switch which may be disposed on the instrument board, steering wheel, or other place within convenient reach of the car operator. Patent 1726961. Frederick L. Marsh.

Automobile Top Pad—Which may be included with the original construction of a car or incorporated into tops already built, for preventing injury to the heads of occupants when subjected to sudden jolts. Patent 1728093. George E. Wintz.

Glare Shield for Rear-View Mirrors—Which will permit a screen to be drawn across the face of the mirror and secured for the purpose of protecting the eyes of the driver from the glaring headlights of a following vehicle. Patent 1728123. William E. Hummel.

Masking Tape—Comprising a strip of flexible material narrow in width and having adhesive sides for permitting a protecting paper to be secured for protecting the painted parts of an automobile body. Patent 1726744. Albert J. Krug.

Dump-Bed Hoist for Trucks—Which automatically raises or lowers a truck bed when the operator moves a control lever, and automatically returns the control lever to neutral position, after the bed has been moved to its uppermost or lowermost position. Patent 1726723. George T. Summers.

Device for Preventing Retrograde Movement of Vehicles—Through the action of a locking device directly associated with the drive shaft of an automobile which will prevent retrograde rotation of the shaft when the car is located on an inclined road bed. Patent 1728809. Alfred B. Small.

INDEX TO VOLUME 141, JULY-DECEMBER, 1929

Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Engineering," "Household," "Medicine," "Miscellaneous," etc., under which many items will be found, the location of which otherwise would be very puzzling.

A

AGRICULTURE

Bees, Honey, Home of 158
Celery, Improving 554
Fur Farming Misconceptions 477
Insect Pests, Crop Destroying 124
Pecan Oil from Wastes 525
Pest, a 50,000,000 Dollar. Cattle Grub 181
Potash, New Sources of 252
Reindeer as a Source of Food 104

AIRPLANES. See Aviation.

AIRSHIPS. See Aviation.

ANTHROPOLOGY. See Archeology.

ARCHEOLOGY, ANTHROPOLOGY, AND ETHNOLOGY

Africa, South, What the World Owes to 119
Ancient History from Aloft 242
Antiques, Fake 335
Arabia, North, Early Man in 503
Archeologist's Note Book 502
Archeology, Behind Scenes of 492
Art of Pliocene Man 508
Australian Bushman, Modeling a 287
Cave Man 478
Cave Man's Brain 544
Dentist, Prehistoric Indian 544
England, Invaders of 16
Flint Mines of Grime's Graves 394
Food Distribution, Archeology Solves Problem 502
French Cave Men 478
Herculaneum, Discoveries at 334
Jerusalem, Walls of 60
Kish 151
Lindbergh: Scientist 477
Magnifying Glasses Helped Egyptians 66
Mammoths's Tooth 524
Marble Sculpture and Ultra-Violet Ray 503
Medum, False Pyramid of 502
Mongolians, Slanting Eyes of 86
Mousterian Man 472
Nemi's Barges, Uncovering 35, 334
Pliocene Man, Art of 508
Race, Extinct 472
Reindeer Roamed the Pyrenees, When 478
Sculpture, Prehistoric 478
Scythian Bronzes 502
Sinai 376
Sumerian Harp 492
Ur 492

ARCHITECTURE. See Building Construction and Fine Arts.

ARMY AND NAVY.

Boilers, Lowering Huge 482
Fleet, Salvaging a Scuttled 473
Guns, California's 14
Japan's New Navy 396
Mechanized Force, Our Army's 216
Naval Accord, Jeopardizing 381
Naval Reduction and Parity 320
Parity and the Public 289
Pensacola, Launching of 15
Rifles, Designs for 526
Tank, British 111
Tank, Fighting, Our Newest 246
Torpedo Plane Suit 267

ASTRONOMY

Amateur Astronomer 82, 176, 258, 354, 448, 542
Amateurs, Practical Astronomy for 426
Canned Astronomy 200
Comets, Puzzles of the 400, 496
Earth Shine 30
Heavens Month by Month 84, 182, 262, 356, 450, 542
Jungfrau Observatory 14
Meteor, Large, Falls 323
Meteors 316
Planetarium 200
Planets, Puzzle of the Major 138
Star Light, What Becomes of the 220
Star Maps 84, 182, 262, 356, 450, 542
Telescope, Silvering World's Largest 225
Telescopes, Amateur 82, 176, 258, 354, 448, 542
Telescopes, Large, Designing 237

ATHLETICS. See Sports.

AUTOMOBILES

Automobile Uses 100 Chemicals 350
Automobile Parts, "Just-as-Good" 267
Banking by Auto 344
Brake, Hydraulic 180
Cape to Cairo Highway 154
Elephants Should Carry Lights 109
Gasoline and Alcohol Mixture 438
Highway Safety Illumination 434
Motorists, Sudden Death of 74
Road for Motorists, Thrill 14
Roads, Ugly 381
Sand Spreaders, Anti-Skid 162
Street Cleaning Trucks, Sanitary Bodies for 160
Ventilator for Rear Window 162

AVIATION

Air Country Clubs 205
Aircraft, Exporting 249
Aircraft Sales, Financing 249
Airplane Catapult 293
Airplanes in 1936, How Many in 164
Airplanes Tested in Tunnel 15
Airport Competition, Lehigh 71
Airport Sign and Signal 73
Airport "Stop-Go" 287
Airports 282, 298
Airports and Airways 164
Airship, Metal-Clad 436
Airship Travelers 483
Air Tour, Fifth National 164
Air Transport, Passenger 324, 404, 514
Airway Marking 528
Altimeter, New 336
Altimeter, Radio 528
American Passenger Air Transport 324, 404, 514
Amphibian, Single Wheel 338
Ancient History from Aloft 242
Army Pilot, Our First 72
Autogiro 336
Autogiro, How It Flies 290
Aviation, Future of 313
Aviation Industry, Groupings in the 58
Aviation Law 340
Aviation's Patron Saint (Will Rogers) 283
Blimp at the Capital 483
Blimp, Commercial Possibilities of 116
Boeing 80-A 73
Charting Alaska from Air 207
Charting Canada from Air 214
Cooling System, New 70
Cowling to Reduce Drag 164
Craft, Convertible 165
Cup Races, Timing 495
De Haviland 66 166
Diesels for Airplanes, Are They Practical 222
Dornier Plane, Do. X 318, 337, 488
Eaglerock "Bullet" 72
Eckener Granted Patent 460
"Flamingo" Metal Plane 248
Fly, It Is Safe to 36
Flying Clubs, Private 165
Flying, Learning to 336
Fog Flying, Instruction in 528
Giant Airplanes 488
Glider Salutes Monument 483
Gliding in Germany 248
Goldbeater Skins for Airships 435
Handley Page Slot Mechanisms 436
Hangar, Huge Dirigible 230
Helicogyre 70
Instrument Board, Flush 71
Learning to Fly 144
Light Aeroplane Contest 157
Light Airplane, Selling the 529
Lights, Private, Certification of 436
Lindbergh: Scientist 477
Lowering Parcels from the Air 336
Mooring Masts, Mobile 338
Motor, First Radial? 483
Motor-Warming Sheds, Eskimo 165
Neon Light for Penetrating Fog 435
Parachute Broadcasting 287
Passenger Air Transport, American 324, 404, 514
Passenger Travel, Future of 529
Pneumatic Tubes at Croyden 340
Runway Canopy 482
Safety on Airlines 504
Seadrome, Armstrong 340
Seaplane, World's Largest, Do. X 318, 337, 488
Seed Planting by Airplane 72
Slots and Interceptors 529
South America, Wings of 46
Spin, Physiological Effects of the 454
Streamline, Ideal 166
Tailspin, Fatal 306
Timing Schneider Race 495
Will Rogers and Aviation 283
Zeppelin Flight, Chemistry Helps 527
Zeppelin's American Home 230

B

BASE BALL

Base Ball, "Lively" 310, 435

BIOGRAPHIES AND PORTRAITS

Abbot, C. G. 199
Berliner, E. 288
Boykin, R. M. 197
Brush, C. F. 205
Campbell, Major L. H., Jr. 197
Eastman, George 375
Eckener, Dr. Hugo 281
Edison, Thomas A. 206, 377
Ford Henry 206, 377
Gilbert, H. F. 74
Heath, Lady Mary 4
Hoffman, A. C. 289
Hutchinson, W. T. 269
Keys, C. M. 223
Knox, Capt. D. W. 279
Laird, Dr. D. A. 4
Lawrance, Charles L. 224
Lindbergh, Col. C. A. 285
Murray, T. E. 365
Osborn, Dr. H. F. 103
Pack, W. N. 101
Parkes, Oscar 373
Puleston, Capt. W. D. 288
Rentschler, F. B. 223
Rogers, Will 285
Russell, Dr. Henry Norris 7
Woolley, C. L. 471

BOATS. See also Merchant Marine

Arc-Welded Motor Boats 526
Yachts Transported by Outdoor Motor Power 161

BOTANY

Avocados—Alligator Pears 59
Fungi that Kill 132
Joshua Tree 425
Mushrooms 22

BREWING

Outlawed Industry 428

BRIDGES. See Engineering, Civil.

BUILDING CONSTRUCTION

Beautifying Washington 110
Bricks, Chemistry Helps Make Better 172
Building Stone, Synthetic 89
Concrete, Expansion Effects in 87
Concrete Improved by Soap 88
Office Building of New Era 484
Plaster Laths, Fiber Metal 263
Pneumatic Tubes in Modern Building 484
Skyscrapers Rest on Lead Mattresses 440
Weather, Artificial for Buildings 24, 80

C

CHEMISTRY

Acid Crystals 252
Aluminum Chloride Manufacture 438
Automobile Uses 100 Chemicals 350
Belt Dressing, Chemical, Eliminates Static 170
Bentonite Suitable for Lead Pencils 349
Boiler Scale, Organic Substances Reduce 252
Bricks, Chemistry Helps Make Better 172
Caustic Soda Made by Fluorine 261
Chlorine Carrier 348
Citric Acid Manufacture 545
Columbium May Emerge from Museum 77
Concrete, Expansion Effects in 87
Corn Sugar 429
Corrosion-Resistant Metals Made Immune Electrolytically 78
Cottonseed Grading by Analysis 87
Crucible Material, New 547
Dish Washing, Scientific 174
Ethanolamine Soap Has Many Uses 534
Explosives, Improved 254
Ferric Chloride Becomes Cheap Coagulant 546
Fluorine Commercially Produced 261
Furfural Staple Commodity 78
Genius, Seeking 288
Germany's Chemical Industry Expands 77
Leviathan and Saltwater Corrosion 77
Lignite Absorbs Sulfur Gases 547
Malt Syrup 429
Nitrogen, Fixed 546
Nitroglycerine Tamed 440
Outlawed Industry Comes Back 428
Paint Testing Instruments 174
Peroxide Bleaches Cereals 183
Petroleum Products in Insecticides 348
Power from Polar Cold 77
Protective Coating (Rubalt) 260
Radium, High Cost of 440
Resin, Synthetic, Improves Lacquers 530
Rust Base for Paint 545
Silver as Purification Agent 348
Sionon—A Sugar Substitute 348
Soap Dust, Explosive 350
Soap Making 408
Starch 429
"Stickum" for Stamps 174
Stills, Industrial, Made of Glass 530
Straw, Waste 351
Sulfur in Air Attacks "Wash" 170
Sunflower Seeds as Source of Potash 78
Synthetic Sweet Smells 386
Titanium Pigments 78

"Weighting" Practice, Standardized....... 530
Writing, Age of, Estimating.............. 28
Zeppelin Flight, Chemistry Helps......... 527

CIVIL ENGINEERING
See Engineering, Civil.

CLOTHING

Clean Iron Workers..................... 477
Clothes Make Men Hot.................. 205
What is Wrong With Men's.............. 128

COMMERCIAL PROPERTY NEWS
92, 188, 267, 364, 460, 552
Fish Balls and Fish Cakes............. 269
Inter-Industry Distribution............ 268

COPYRIGHT

Misplaced Copyright Notice Void......... 553
Photograph, Copyright for............... 554
Sleepy Copyright Owners................ 92

CRIME

Banditry by Mail....................... 54
Burglar, Foiling the............... 50, 148, 226

CURRENT BULLETIN BRIEFS
80, 178, 250, 352, 446, 538

D

DAMS. See Engineering, Civil.

DIRIGIBLES. See Aviation.

DRAMA

Stage Goes to School.................. 40

E

EARTH

Power from the......................... 422
Earth Shine............................ 30

EDUCATION

Street Car, Educational................ 527

ELECTRICITY

Arc Light Carbons...................... 87
Arc-Welded Motor Boats................ 526
Book Carrier, Mechanical............... 402
Cotton Imperiled by Static Electricity.... 247
Edison and his Work.................... 377
Electroplating, Thickness of............ 546
Elevator, Electric, for Bananas......... 207
Fig Packing, Electric Heat in........... 65
Flashing Warning Lamp.................. 246
Foot Warmer, Electric.................. 62
Heat, Portable......................... 434
Highway Safety Illumination............ 434
Ice by Wire............................ 390
Incense Burner, Electric................ 63
Lamp Factory, Edison's First............ 206
Light Uses One Third of Electricity...... 527
Lightning, Photography of............... 27
Metal Mine Electrified................. 501
Metal Pouring Device................... 163
Oil, New for Old....................... 183
Photoelectric Comparator............... 366
Portable Heat.......................... 434
Refrigerators, Manufacture of........... 390
Searchlights for Fire Fighters.......... 111
Shock-proof X-Ray Apparatus............ 344
Solderless Wire Connector.............. 433
Steam Power Plants Come Back........... 234
Telephone on Train..................... 111
Time Siren............................. 207
Transformers, Nitrogen Gas for......... 88
U-V Ray Effect......................... 482

ENGINEERING, CIVIL

Blasting, Sand Bags for................ 435
Boulevard on Shifting Sands............ 510
Bridge, Grand Canyon................... 111
Bridge, Spiral Approach to............. 527
Crane, Mobile.......................... 14
Dam, O'Shaughnessy..................... 122
Dam, World's Highest, for Irrigation.... 39
Esthetic Engineering................... 510
Hangar, Huge Dirigible................. 230
Ice Aids in............................ 161
Regrade Engineering.................... 431
Roads, Colombian....................... 8
Roads, Steel Framework for............. 78
Roads, Ugly............................ 381
Steel Scaffolding...................... 385
Roosevelt Highway...................... 287
Wires and Cables for Hudson River Bridge. 518

ENGINEERING, MECHANICAL

Boiler Scale, Organic Substances Reduce... 252
Bolt and Nut Thread, Self-Locking....... 432
Cars, Railway, Cleaning................ 389
Crane, Mobile.......................... 14
Locomotive, America's First............ 247
Locomotive, Gas Firing................. 66
Locomotives, Ten Thousand Miles of...... 163
Lumber Plugging Machine................ 53
Mechanical Movements................... 364
Mechanical Wonderland.................. 364
Pipe Lines............................. 43
Portable Heat.......................... 434
Power from the Earth................... 422
Railroad Cars, Disinfecting............. 206
Steam Stages a Come-Back............... 234
Train-Carrying Ship.................... 21
Vibration for Boat Propulsion........... 56
Water Pipes, Frozen, Prevention......... 432

ETHNOLOGY. See Archeology.

EXPLOSIVES

Improved............................... 254

F

FINE ARTS

Beautifying Washington................. 110
Dossena at Work........................ 334
Egyptian Motives for Furniture.......... 334
Stone Carving by Sand Blasting.......... 342
Washington, the Greater................ 330

FIRE FIGHTING

Carbon Dioxide Gas Used to Fight Fire.... 534
Fire Alarm Senders Photographed......... 207
Forrest Fire Lookout................... 526
Railway Snow-shed Fires................ 524

FISHERIES

Fish Fussy about Salt.................. 534
Golf Ball Murders Fish................. 543
Sardine Packing........................ 419

FLYING. See Aviation.

FOODS

Alligator Pears—Avocados............... 59
Botulism and Home Canning.............. 74
Candy Mints............................ 521
Cereals Bleached by Peroxide............ 183
Corncobs Yield New Sweet............... 68
Dining-Car Staff Goes to School......... 513
Fig Packing, Electric Heat in........... 64
Licorice the Versatile................. 208
Mushrooms.............................. 22
Queer Foods............................ 206
Reindeer as a Source of Food........... 104
Sardine Packing........................ 419
Sionon—A Sugar Substitute.............. 348
Vineyard, World's Largest.............. 240

FORESTRY

Forest Fire Lookout.................... 526
Joshua Tree............................ 425
Lumber Plugging........................ 53
Praying Trees of the Desert............ 425
Reforestation.......................... 13
Tractors Drag Logs..................... 247
Weighing Moisture of Lumber in Kilns.... 433

FOSSILS. See Geology.

FUELS

Anthracite Chokes Rivers............... 160
Gasoline and Alcohol Mixture........... 438
Hydrogenation in Gasoline Production.... 252
Metaldehyde as Fuel.................... 88
Oat Hulls for Fuel..................... 67
Oil Gusher, Why Does it Gush?........... 212
Petroleum, What Is..................... 170
Pipe Lines for Oil and Gas............. 43
Powdered Fuels for Engines............. 530

G

GASOLINE. See Fuels.

GEOLOGY

Dinosaur Leg Bone...................... 15
Fossil Reptiles........................ 115
Mammoth's Tooth........................ 524
Meteor, Large, Falls................... 323
Meteors................................ 316
Oil Gusher, Why Does it Gush?........... 212
Power from the Earth................... 422
Seismology, Amateur.................... 411

GOLF. See Sports.

GLIDERS. See Aviation.

H

HOUSEHOLD ARTICLES

Foot Warmer, Electric.................. 62
Incense Burner, Electric................ 63
Lamp and Globe......................... 63
Roaster, Three Piece................... 63
Steel Wool Polisher.................... 62

I

IRRIGATION

Aid to................................. 162
Dam, World's Highest for Irrigation...... 39

L

LEATHER

Reptile Leather Industry............... 420

LIBRARIES

Mechanical Book Carrier................ 402
Study Rooms............................ 403

LICORICE............................... 208

LIGHT

Edison's First Electric................ 378
Light Holds Universal Speed Record...... 414
Symphonies in Light.................... 264
Weighing with Light.................... 416

LOCKS AND KEYS

Burglar, Foiling the............... 50, 148, 226
Locks, Time and Combination............ 226

LOCOMOTIVES

See Engineering, Mechanical.

M

MARINE EQUIPMENT. See Safety.

MECHANICAL ENGINEERING. See Engineering, Mechanical.

MECHANICS. See Engineering, Mechanical.

MEDICINE

Anemia, Dried Hog Stomach for.......... 525
Anemia, Liver and Iron in.............. 536
Arsenical Poisoning.................... 250
Asthma, Reflex Itching in.............. 85
Backache in Golf and Polo.............. 168
Baldness, Nervous...................... 537
Bathing Accidents...................... 346
Blindness Caused by Battery Fluid....... 85
Botulism and Home Canning.............. 74
Carbon Monoxide Deaths................. 537
Chemical Burns......................... 89
Cockroaches, Damages for............... 76
Compressed Air in Novel Hospital........ 244
Constitution and Reproduction........... 167
Digestion, Effects of Emotion on........ 86
Digestion of Meat...................... 75
Drug Store, Modern..................... 13
Ethylene, Dangers of................... 250
Eye Examination of Children............ 536
Fish Tapeworm Infestation.............. 167
Food, Sensitivity to................... 250
Garage Deaths.......................... 537
Health and Happiness................... 12
Heart Disease, Conquering of............ 74
Heart Rate During Sleep................ 346
Infants, Body Builds of................ 76
Iodine Surveys......................... 442
Licorice the Versatile................. 208
Medicine Chest, Everything for the...... 532
Mental Excitement and Brain Stimulation 75
Mongolians, Slanting Eyes of............ 86
Mosquitoes and Horses.................. 74
Motorists, Sudden Death of............. 74
Muscle, Machinery of................... 18
Radioactive Waters..................... 442
Radioactivity After Death.............. 75
Railroad Cars, Disinfecting............. 206
Refrigeration Gases, Poisonous.......... 381
Respiration, Artificial................ 64
Respiration, Mechanical................ 524
Ringworm of the Feet.............. 442, 536
Shoes for the Baby..................... 168
Shoes, Right and Wrong................. 444
Smoke Encourages Pneumonia............. 260
Snake Bite............................. 109
Spectacles, Fraudulent................. 289
Sulfur Dioxide Hazard Exaggerated....... 78
Tobacco Smoking........................ 442
Tularemia from Muskrat................. 85
Tularemia in Russia.................... 444
Weather and Pain in the Joints.......... 250
X-ray Apparatus, Shock-Proof............ 344
X-ray Films, Danger from............... 167
U-V Ray Effect......................... 482

MERCHANT MARINE

Bow Rudder............................. 206
Bremen........................... 229, 293
Cable-laying Ship...................... 110
Maritime Law Laxity.................... 12
Sea Safety Contest................ 229, 491
Train-Carrying Ship.................... 21
Vibration, Propelling Boats by.......... 56

METEOROLOGY............................ ...

Neon Light for Fog Penetration......... 335
Radio Does Not Make Rain............... 247
Weather, Artificial, for Offices.... 24, 80
Weather and Pain in the Joints......... 250

METALLURGY. See MINES AND METALLURGY.

MICROSCOPY

Diatoms 112

MINES AND METALLURGY

Alloy, Heat Resistant 440
Aluminum Dust, Burning 534
Gold Beating 110
Iron Wire Acts Like Nerves 358
Konel, New Alloy by Westinghouse 432
Metal Mine, Electrified 501
Metal Pouring Device 163
Metals, Corrosion-Resistant Made Immune Electrolytically 78
Nickel Welded With Flux 351
Nitrogen Treatment for Case-hardening Steel 77
Oxygen Lance for Cutting 433
Potash, New Sources of 252
Pre-heating in Shop Welding 451
Razor Blade Science 302
"Spotting" of Electro-plated Metals 252
Sulfur Mining 365
Tunnel Yields Its Cost in Gold 181
Vault Construction 148
Zinc, Pure 349

MISCELLANEOUS

Ball, "Lively" Base 310
Banking by Auto 344
Burglar, Foiling the 50, 148, 226
Cable-laying Ship 110
Candy Mints 521
Cigarette Container and Ash Tray 63
Cigarettes, Self-Lighting 246
Cockroaches, Damages for 76
Dining-Car Staff Goes to School 513
Drug Store, Modern 13
Ear Phone 62
Fido, Health Food for 188
Gas Smeller in Berlin 207
Ice, Imitation for Skating 89
Incense Burner 63
Liberty Bell, Reinforcing 110
Light, Symphonies in 264
Locks, Time and Combination 226
Mail Box, Waterproof 15
Men's Clothing, What Is Wrong With 128
Money, Small Bills 211
Mongolians, Slanting Eyes of 86
Muscle, Machinery of 18
Outlawed Industry 428
Pencil-Lighter 63
Photographing Books 111
Pneumatic Tubes 484
Razor Blade Science 302
Reptile Leather Industry 420
Robot, More About 264
Robot, What Is a? 64
Shoes for the Baby 168
Shoes, Right and Wrong 444
Soap Making 408
Stage Goes to School 40
"Stickum" for Stamps 174
Telephone Book Rack 62
Time Siren 207
Ultra-violet Rays for Manuscripts 357
Vault Manufacture 148
Vineyard, World's Largest 240
Wall Street and the Research Laboratory 381
Watch, Dustless Wrist 452
Water-tight Purse 15
Word Writing Machine 553
Writing, Age of 28
X-ray Detects Smuggled Diamonds 263

MONEY

Small U. S. Bills 211

MOVING PICTURES AND TALKING FILMS

Apparatus for "Talkie" Film 206
Cyclorama 482
Enlargements from Amateur Movies 68
Machine Gun, "Movie" 482
Shooting Wild Life With a "Movie" Camera 140
Sound Proof Cage 207
"Talkie" Headphones 483

N

NATURAL HISTORY

Ant "Cowboys" 181
Antlers, Old and New 147
Bees, Honey, Home of 158
Bees "Sweet Tooth" Measured 358
Bird's Companionate Marriage 160
Camel's Hump 137
Goats, Photographing 140
Insect Pests 124
Loon Poses for Camera 152
Man versus the Insect 109
Monkey-Shines 294
Reindeer 105
Sea-worm, Minced, Turns Into Family 68
Shooting Wild Life With a "Movie" Camera 140
Snake Bite 109
Snakes, Truth About 134
Zoo, Feeding the 131

NAVY. See ARMY AND NAVY.

O

OFFICE APPLIANCES

Cigarette Container and Ash Tray 63
Ear Phone 62
Floor Connections, Electric 63
Pencil-Lighter 63
Rubber Stamp, Flexible 62
Telephone Book Rack 62

OIL. See FUELS.

OILS AND LUBRICATION

Oil, New for Old 183

P

PATENTS AND TRADEMARKS

Automobile Parts "Just-as-Good" 267
Capitalism and the Patent System 93
Castoria Decision 268
Discontinuance Not Abandonment 460
Celery, Patent on Improving 554
"Doctor B. F. Davis" Trademark 268
Dogs, Health Food for 188
Drugs, Cut Rate on 365
Eckener Granted Patent 460
Edison and His Work 377
Employer Restrained from Using Patent 188
First Patent Petition 460
Foreign Rights to Patents and Trademarks 92
Geographical Term Allowed in Trademark 93
Grape Trademark Held Invalid 554
Hutchinson, Patent Examiner 269
Infringement, Useless Step in 267
Insulating Material Patented 554
Inter-American Trademark Bureau 92
Inventing, Who Does the? 267
Italian Inventions 189
Joseph Jenks' Petition 460
"Mama" Dolls Patents Infringed 460
Mark Refused Registration 364
Mechanical Method Claims 460
Neon Tube Cleaning, No Infringement 552
Patentability of Combination 364
Patent Attorney—Friend or Enemy? 188
Patent Law Abroad 460
Patent Protection Still Effective 552
Patents Recently Issued 93, 189, 268, 365, 461, 553
"Penn-Allen" Registered as Trademark 461
Potato Chip Degreaser, Protection for 461
Rotarians Guard Their Name 93
Sleeve Valve Motor Patent 267
Torpedo Plane Patent Suit 267
Trademark Not Used, Denied 365
Trademarks, Joint Use of 365
"Walker on Patents" 188
Wanted, a Genius 189
War Claims 366
Yeast Patents Awarded on Appeal 92

PETROLEUM. See FUELS.

PHONOGRAPHS

Phonograph Speedometer 69

PHOTOGRAPHY
See also MOVING PICTURES AND TALKING FILMS.

Ancient History from Aloft 242
Charting Alaska from Air 207
Charting Canada from Air 214
Lightning, Sky Photography for 27
Photographic Display, Continuous 66
Photographing Books 111
Wild Life, Shooting With a "Movie" Camera 140

PHYSICS

Marble Sculpture and Ultra-Violet Ray 503
Radioactivity After Death 75
Speed Record of the Universe 414
Ultra-Violet from the Sun 32
Weighing With Light 416
Weights at Bureau of Standards 110

PLANETARIUM 200

PORTRAITS. See BIOGRAPHY AND PORTRAITS.

PSYCHOLOGY

Men's Clothing, What Is Wrong With 128
Mental Excitement and Brain Stimulation 75
Muscle, Machinery of 18

R

RADIO. See Also TELEVISION.

Parachute Broadcasting 287
Radio Does Not Make Rain 247
Radio in 1930 498

RAILROADS

Cars, Cleaning 206, 389
Car Ferry 21
Dining-Car Staff Goes to School 513
Locomotive, America's First 247
Lounge Cars 64
Snow-shed Fire Fighting 524

RAYS

Marble Sculpture and Ultra-Violet Ray 503
Ultra-Violet Rays and Manuscripts 357
X-Ray Detects Smuggled Diamonds 263
X-Rays in Industry 256

REFRIGERATION

Heat-Makes-Cold Refrigeration Unit 245
Ice by Wire (G. E. Refrigerator) 390
Refrigerator Gases, Poisonous 381
Sulfur Dioxide Hazard 78

ROADS

Colombian 8
San Francisco Boulevard Built on Sand 510
Steel Framework for Paving 78

ROBOT, What Is a? 64, 264

RUBBER

Protective Coating 260
Synthetic Rubber 342

S

SAFETY

Accidents, Fatal 477
Bathing Accidents 346
Chemical Burns 89
Elephants Should Carry Lights 109
Ethylene, Dangers of 250
Flashing Warning Lamp 246
Fly, It Is Safe to 36
Gas Smeller in Berlin 207
Highway Safety Illumination 434
Lifeboat, Every Ship a 205
Maritime Law Laxity 12
Railroad Cars, Disinfecting 206
Respiration, Mechanical 524
Sand Spreader, Anti-Skid 162
Searchlights for Fire Fighters 111
Sea Safety Award 491
Sea-Safety Contest 229
Steel Scaffolding 385
Street Cleaning Trucks, Sanitary Bodies for 160
Wing Signals, Rattan 14
X-Ray Films, Danger from 167

SANITATION

Dust and Dirt, City 109

SCIENCE

Evolution, Do Any Scientists Deny It? 161
Health and Happiness 12
Science, Significance of 12
Wall Street and the Research Laboratory 381

SEISMOLOGY

Amateur Seismology 411

SPORTS

Backache in Golf and Polo 168
Ball, The "Lively" Base 310, 435
Base Ball, "Lively" 310, 435
Diving from a Gun 15
Golf Ball Murders Fish 543
Golf Game, Indoor 63
Golf Practice 287
Ice, Imitation, for Skating 89
Motorists, Thrill-Road for 14
Tennis Nets, Tightener 62
Trap Which Catches Animals Alive 433
Water-tight Purse 15
Water Wings, Novel 63

T

TALKING PICTURES. See MOVING PICTURES AND TALKING FILMS.

TELESCOPES. See ASTRONOMY.

TELEVISION

Television's Progress 487

TEXTILES

Cotton Imperiled by Static Electricity 247

THEATER

Stage Goes to School 40

TOOLS

Lumber Plugging Machine 53

TOYS

Baby Roadster 62

TRADEMARKS. See PATENTS AND TRADEMARKS.

TRAVEL AND EXPLORATION

Africa, South, What the World Owes to 119
Cape to Cairo Highway 154
Jerusalem, Walking Around 60

TREES. See FORESTRY.

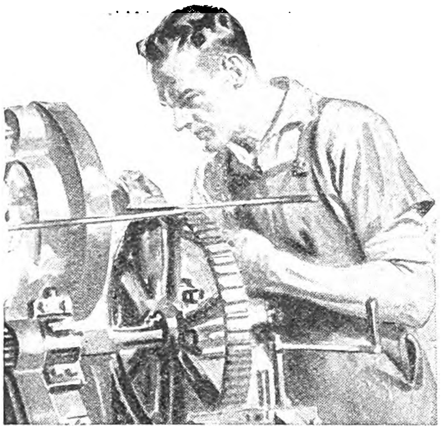
U

ULTRA-VIOLET FROM THE SUN 32

W

WASTE

Reclamation of Waste Nets Large Savings 67



He's Patented Four Inventions

And he's only one of scores of inventors who got their first real start through spare-time study with the International Correspondence Schools.

Jesse G. Vincent, Vice President of the Packard Motor Car Company, inventor of the Packard Twin Six and co-inventor of the Liberty Motor, is a former I. C. S. student.

So is John C. Wahl, inventor of the Wahl Adding Machine and the Eversharp Pencil; W. E. Hallett, inventor of the Hallett Tandem Gas Engine; H. E. Doerr, Chief Mechanical Engineer, Scullin Steel Company, and W. J. Libby, inventor of the Libby Mine Hoist Controller.

Here's the same coupon—the same opportunity that these men had. There's still a chance for you to get ahead if you will only make the start.

One hour after supper each night, spent with the International Correspondence Schools in the quiet of your own home, will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost or obligation, just mark and mail this coupon.

Mail this Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
"The Universal University"
Box 6113-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, **"Who Wins and Why,"** and tell me how I can qualify for the position, or in the subject, *before* which I have marked an X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect
☐ Architectural Draftsman
☐ Building Foreman
☐ Concrete Builder
☐ Contractor and Builder
☐ Structural Draftsman
☐ Structural Engineer
☐ Electrical Engineer
☐ Electrical Contractor
☐ Electric Wiring
☐ Electric Lighting
☐ Electric Car Running
☐ Telegraph Engineer
☐ Telephone Work
☐ Mechanical Engineer
☐ Mechanical Draftsman
☐ Machine Shop Practice
☐ Toolmaker
☐ Patternmaker
☐ Civil Engineer
☐ Surveying and Mapping
☐ Bridge Engineer
☐ Gas Engine Operating
☐ Automobile Work
☐ Aviation Engines
☐ Plumber and Steam Fitter
☐ Plumbing Inspector
☐ Foreman Plumber
☐ Heating and Ventilation
☐ Sheet-Metal Worker
☐ Steam Engineer
☐ Marine Engineer
☐ Refrigeration Engineer
☐ R. R. Positions
☐ Highway Engineer
☐ Chemistry
☐ Pharmacy
☐ Coal Mining Engineer
☐ Navigation ☐ Assayer
☐ Iron and Steel Worker
☐ Textile Overseer or Supt.
☐ Cotton Manufacturing
☐ Woolen Manufacturing
☐ Agriculture ☐ Fruit Growing
☐ Poultry Farming
☐ Mathematics ☐ Radio

BUSINESS TRAINING COURSES

☐ Business Management
☐ Industrial Management
☐ Personnel Management
☐ Traffic Management
☐ Accounting and C. P. A. Coaching
☐ Cost Accounting
☐ Bookkeeping
☐ Secretarial Work
☐ Spanish ☐ French
☐ Salesmanship
☐ Advertising
☐ Business Correspondence
☐ Show Card and Sign Lettering
☐ Stenography and Typing
☐ English
☐ Civil Service
☐ Railway Mail Clerk
☐ Mail Carrier
☐ Grade School Subjects
☐ High School Subjects
☐ Illustrating ☐ Cartooning
☐ Lumber Dealer

Name..

Street Address..

City.......................State.......................

Occupation..

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—DECEMBER, 1929

Alexander Aircraft Company 543
Allied Radio Corporation 548
American Lead Pencil Company 544
American Pipe Bending Machine Company 548
American Thermo Ware Co 546
American Tobacco Company (Fourth Cover)

Francis Bannerman Sons 548
Bartlett-Hayward Co 537
Bernard & Heller 546
Box 193 546
Broderick & Bascom Rope Company 541

Chicago Gear Works 548
Chicago Technical College 547
Crescent Tool Company 546

Delta Specialty Company 533
Dodge Brothers Trucks (Second Cover)
Du Maurier Company 548
Edwin Cigar Co 544
Elec. Service & Eng. Bureau (P. O. Box 132) 546

Florsheim Shoe Co 543
Forbes Publishing Company 468
Ford Motor Company (Aviation) 470
French Electric Co., Inc 546

Gillette Safety Razor Company (Color Insert)
Gilson Slide Rule Company 544

International Correspondence Schools 560
International Typewriter Exchange 548

Keasbey & Mattison 544
Otto Konigslow Mfg. Company 546

Laboratory Materials Company 544
E. Leitz, Inc 545

Marvin Cigar Co 547
Masonite Corporation 531
Metal Cast Products Company 544
Metallic Sign Letter Company 544
Milwaukee Die Casting Company 539
Wm. Mogey & Sons, Inc 543
Munn & Co 543 & 546

National Tuberculosis Assn 549
New Method Mfg. Co 546

C. A. Olson 548

Pacific Technical University 547
Packard Motor Car Company (Third Cover)

Review of Reviews Company 535
Roat & Lohman 542 & 546
Ruxton Multi-Vider Corp 542

Schwerdtle Stamp Co 547
Science News-Letter 544
Charles A. Scott 546
Signal Electric Mfg. Company 547
S K F Industries, Inc 465
Stephenson Laboratory 547

Timken Roller Bearing Company 466

Unisol Mfg. Company 542

Veeder-Root, Inc 555
H. von Schon 548

Westinghouse Electric & Mfg. Co (Insert)
Wollensak Optical Co 548

Henry Zuhr, Inc 546

Francis N. Pruyn,
Advertising Manager

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor
Albert A. Hopkins
Albert G. Ingalls
Louis S. Treadwell
A. P. Peck
F. D. McHugh
Henry W. Hough
Professor Henry Norris Russell
Professor Alexander Klemin

CORRESPONDING EDITORS

Ernest W. Brown, Sterling Professor of Mathematics, Yale University.

A. E. Buchanan, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

Morris Fishbein, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

William K. Gregory, Professor of Vertebrate Paleontology, Columbia University.

Leon A. Hausman, Professor of Zoology, New Jersey College for Women.

Paul R. Heyl, Physicist, United States Bureau of Standards.

David Starr Jordan, Chancellor Emeritus, Leland Stanford Jr. University.

Waldemar Kaempffert, Director Museum of Science and Industry, Chicago.

M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MacDougal, Associate in Plant Biology, Carnegie Institution of Washington.

Roy W. Miner, American Museum of Natural History.

Russell W. Porter, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

Dr. Walter Franklin Prince, Research Officer, Boston Society for Psychic Research.

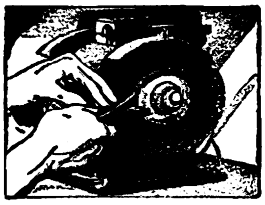
W. D. Puleston, Captain, United States Navy—Technical Adviser on Military Matters.

Elihu Thomson, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

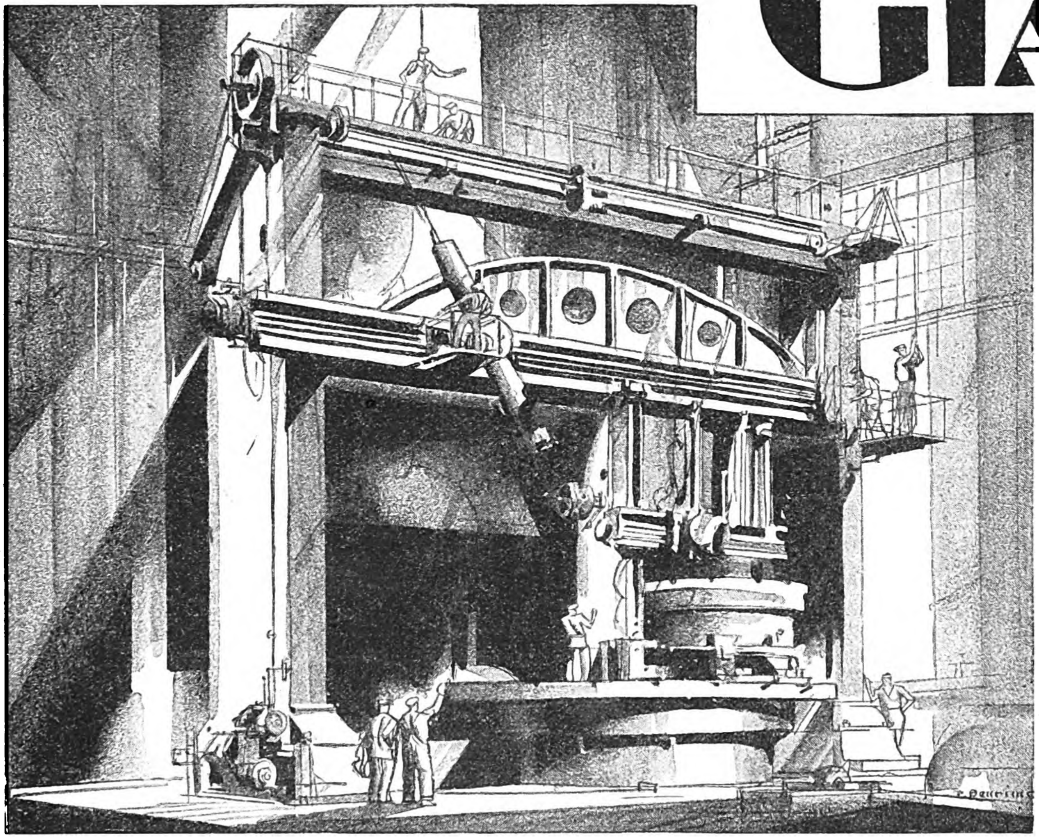
R. W. Wood, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 6. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

From pygmies



to GIANTS



Giant Vertical Boring and Turning Mill built by William Sellers & Co. of Philadelphia, Pa. ...equipped with SKF Anti-Friction Bearings.

At top: A small tool grinder that is also SKF-equipped.

GOOD PERFORMANCE *demands*

"The Highest Priced Bearing in the World"

THAT'S the thing upon which to base your choice of a bearing..... PERFORMANCE..... nothing else in all the world counts..... least of all PRICE!

For there's many a man who has bought a cheap bearing at a bargain. But try and find the man who ever got a bargain out of USING one.

It costs more to produce SKF Anti-Friction Bearings... more for the special steels that go into them... more for the precision manufacturing that produces them. But it costs less—FAR less—to use them.

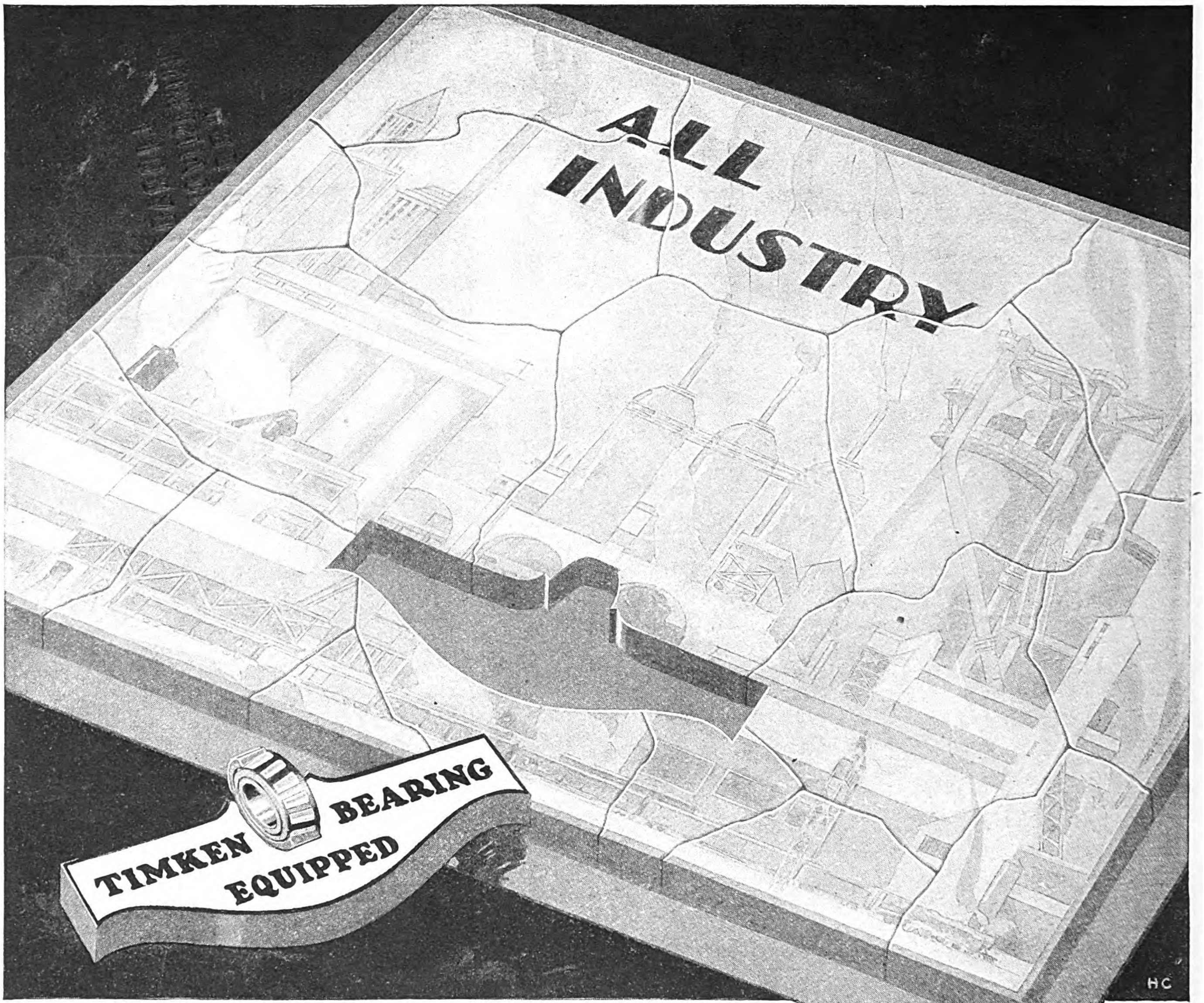
SKF INDUSTRIES, INC., 40 East 34th St., New York, N. Y.

143 machine tool manufacturers use SKF Anti-Friction Bearings

SKF

The Highest Priced Bearing in the World

2372



Solving the Production Puzzle

What puzzles Industry most is Waste. The moment "Timken Bearing Equipped" is placed into the picture . . . the bearing problem is solved.

Timken fits into modern production plans as only Timken can. For Timken is *the one bearing that does all things well.* Let the load be all radial, or all thrust, or both in combination . . . let the burden be heavy . . . the pace killing . . . Timken compact, self-contained carrying ability will suit itself to the situation and *carry on.*

Waste meets its Waterloo; friction loses its grip; lubricant becomes a matter of little or no consequence; machinery stays young; costs catapult downward; profits soar skyward.

Industry has placed Timken Bearings on jobs thought impossible. Timken has made them profitable. So today old methods give way before Timken, replacing obsolete machines with machines that are "Timken Bearing Equipped" . . . meeting and mastering the mighty march of modern Industry.

The exclusive Timken combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel is summed up in "Timken Bearing Equipped"—universal symbol for designing and buying machinery that serves, saves and endures *wherever wheels and shafts turn.*

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* BEARINGS

©1929, The Timken Roller Bearing Company

SCIENTIFIC AMERICAN

24 WEST 40th STREET NEW YORK CITY

December 1929 *Edited by ORSON D. MUNN* *Eighty-fifth Year*

IN THIS ISSUE

Looking Ahead With the Editor 469

Among Our Contributors 469

Back of Frontispiece—C. Leonard Woolley 471

Frontispiece—Mousterian Man, Woman, and Child 472

A Scuttled Fleet Is Salvaged—By David Masters 473
A Man Without Salvage Experience Raises the German Fleet

Our Point of View—Editorials 477
Lindbergh: Scientist; Fatal Accidents; "White Pants" Workers; Fur-Farming Misconceptions

When Reindeer Roamed the Pyrenees—By Ida Treat, Ph.D. 478
France, "Capital of the Prehistoric World," In Cave Man Days

From the Scrap-book of Science 482
Camera Shots of Scientific Subjects

An Office Building of the New Era—By Stratford Corbett 484
Science Contributes to Efficiency, Comfort, and Convenience

Television's Progress—By A. P. Peck 487
What Has Been Done and What We May Expect in the Future

Giant Airplanes—By Reginald M. Cleveland 488
In Which Is Foreseen a New Era in Heavier-than-Air Flying

Award of the Scientific American Medal 491
An Awakened Interest in Sea Safety Has Brought Results

Behind the Scenes in Modern Archeology—By Horace H. F. Jayne 492
Restoration for Exhibition of Field Discoveries

Timing the Schneider Cup Races 495
Recording the Speed of Planes Racing at Over 300 Miles Per Hour

The Puzzles of the Comets—II—By Henry Norris Russell, Ph.D. .. 496
The Sun Picked Up Its Family of Comets Only Recently

Radio in 1930—By Howard T. Cervantes 498
The Final Test of a Set Is Its Tone Quality

Largest Electrified Metal Mine 501
"Strip" Copper Mine Adds Electric Locomotives

From the Archeologist's Note Book 502
Scythian Bronzes; Primitive Art and Food; "False Pyramid"; Early Man in North Arabia; Marble Sculptures and U-V Ray

Insuring Safety on Airlines—By Lester D. Seymour 504
Behind the Pilot Is a Far-reaching Organization

The Art of Pliocene Man—By J. Reid Moir 508
New Discoveries Indicate That Ancient Man Was Highly Intelligent

Esthetic Engineering—By C. W. Geiger and Ruth Sabichi 510
Beautiful Boulevard Is Built by Anchoring Shifting Sands

When the Dining-Car Staff Goes to School 513
Personal Instruction of Waiters and Cooks Is Necessary

American Passenger Air Transport—III—
By Prof. Alexander Klemin 514
Further Pertinent Facts Concerning Engines, Pilots, Et Cetera

Wires and Cables for a Great Bridge—By A. E. Cripps 518
Manufacture of Wires for the Cables of the Hudson River Bridge

Rebuilding a Broken Business—By Milton Wright 521
A Huge Candy Industry Developed Through Research

Scientific American Digest 524
- Mammoth's Deformed Tooth 524
- Mechanical Respirator 524
- Snow-shed Fire Fighters 524
- Pecan Oil From Wastes 525
- Dried Hog Stomach New, Cheaper Anemia Remedy 525
- Semi-automatic Army Rifles (Illustration) 526
- Arc-welded Steel Boats 526
- Fire Lookout On Tall Tree 526
- Spiral Approach to Bridge (Illustration) 527
- Educational Street Car 527
- Light Uses Third of Electricity ... 527
- Chemistry Helped *Graf Zeppelin* .. 527
- Golf Ball Murders Fish 543
- Burn Aluminum Dust for Intense Flame 543
- Cave Man's Brain Found 544
- Prehistoric Indian Dentists 544

Learning to Use Our Wings 528
- Radio Altimeter 528
- Instruction in Fog Flying 528
- Airway Marking 528
- Slots and Interceptors 529
- Selling the Light Airplane 529

Chemistry In Industry 530
- Synthetic Resin for Lacquers 530
- Powdered Fuels for Engines 530
- Industrial Stills of Glass 530
- Standardized Weighting Practice .. 530
- Everything for Medicine Chest (Illustrations) 532
- Ethanolamine Soap Uses 534
- Carbon Dioxide Gas for Fighting Fires 534
- Fish Fussy About Salt 534
- Making Citric Acid 545
- Rust Used in New Paint Base 545
- Binding Fixed Nitrogen 546
- Thickness of Electro-plating 546
- Ferric Chloride, Cheap Coagulant 546
- Lignite Absorbs Sulfur Gases 547
- New Material for Crucibles 547

The Month in Medical Science . 536
- Liver and Iron in Anemia 536
- Eye Examinations for Children ... 536
- Ringworm of the Feet 536
- Nervous Baldness 537
- Garage Deaths 537

Current Bulletin Briefs 538

The Amateur Astronomer 540

The Heavens in December 542

Commercial Property News 552
- Reward Awaits Inventor 552
- Cleaning Neon Tubes 552
- Patent Protection Effective 552
- Word Writing Machine Perfected .. 553
- Misplaced Copyright Notice 553
- Copyright for Photographs 554
- Method for Improving Celery 554
- Insulating Material Patented 554
- Trademarks for Grapes Invalid ... 554

Patents Recently Issued 553

Index to Volume 141 557

COVER

Our cover picture this month represents the scientific restoration of a Neandertal man and his family, as described on page 472. The painting, by our artist Howard V. Brown, was made from a copyrighted photograph of the group in the Field Museum of Natural History in Chicago, which was recently placed on exhibition. The colors are not vivid but as far as present knowledge is concerned, they are scientifically accurate.

for EXECUTIVES who use

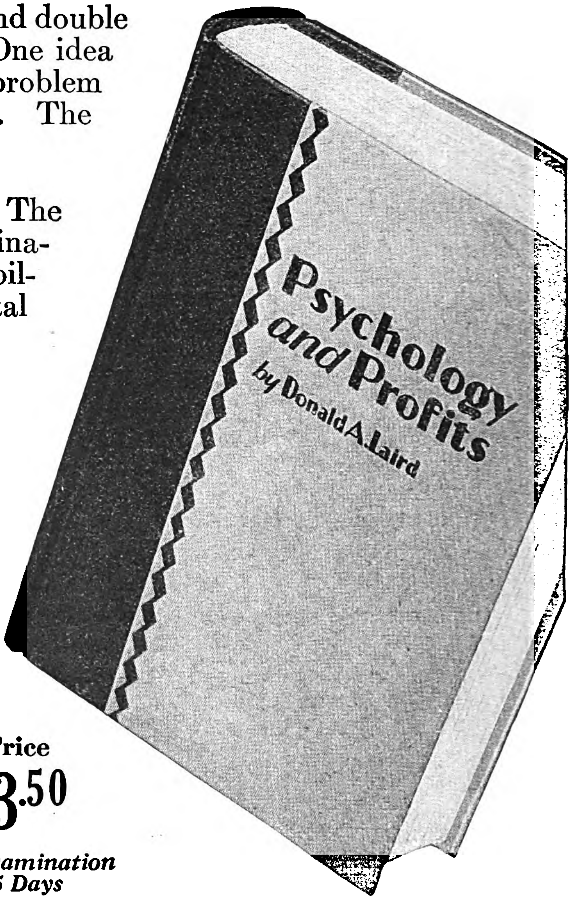
manpower

HERE is a book that will strengthen your control—and double the efficiency of each man working under you. One idea in this book cost an executive $4,679 and solved a problem which saved his firm over $55,000 a year thereafter. The book is crammed full of ideas just as valuable.

Human nature is the most unstandardized thing known. The possible variations in human make-up stagger the imagination. No two men in this wide world can be alike in ability. To get the most out of each man, therefore, is a vital problem which only psychology can solve.

Donald A. Laird, director of the Colgate Psychological Laboratory, and one of the highest paid Consulting Psychologists in America, has gathered into book form the fruit of his many years of intensive research and experiment in laboratories of human engineering—and in PSYCHOLOGY *and* PROFITS he applies psychology to business and *makes it earn more dividends.*

The ideas in this volume as first used to solve the intricate problems of Dr. Laird's business clients cost them thousands of dollars. Now you have an opportunity to get this accumulated wisdom in permanent form for 5 days *free* examination merely by tearing and returning this coupon.



Price

$3.50

Free Examination for 5 Days

DO YOU KNOW THAT—

—hard work is the sign of a misfit? The right job is always *easy?*
—sour people have poor memories?
—a mental age of twelve is needed for driving a car safely?
—there is an area on your desk that is most effective for working?
—each long service man under you is really a new man?
—while Police Commissioner in New York Theodore Roosevelt made a psychological discovery that led him to discover General Pershing?
—most executives have a "yellow streak" that costs business millions each year?
—most old-fashioned "craftsmen" were just lazy dabblers?
—the slow worker is not the accurate worker?
—the best years for learning are from sixteen to twenty-five?
—ultra-violet light does not benefit factory production?
—George M. Cohan has a good reason for carrying his office in his hat?
—enforced idleness can be used to hatch new ideas?
—most of your workers are in fact only one-armed?
—private offices should not be placed at the rear of a general office?
—industry is handicapped by The Bishops' Error?
—Germany excels us in man-power engineering?
—sleeping with one's problems helps bring solutions?
—rubber heels are unwise for the man who lacks confidence?
—you have to hire a family to fill one job?

Psychology
and
Profits
by **Donald A. Laird**

At Your Bookstore or on Five-Day Approval from
B. C. FORBES PUBLISHING COMPANY,
120 Fifth Avenue, New York City, Department S. A.

I want to read "Psychology and Profits." After five days I will return it to you, or remit $3.50. Please send me the book.

NAME...

ADDRESS..

Scientific American, December, 1929, Vol. 141, No. 6, entered at the New York, N. Y., Post Office as Second Class Matter June 28th, 1879, under the Act of March 3rd, 1879; additional entry at Dunellen, N. J. Published Monthly by Scientific American Publishing Co., 24 West 40th Street, New York City. Copyright 1929 by Scientific American Publishing Co. Great Britain Rights Reserved. Subscription Price $4.00 per year.

Looking Ahead *With the* Editor

January—Automobile Number

"WHAT car shall I buy this year?" is a question that begins to disturb the thoughts of many people about the first of each year. Others who do not wish or do not need a new car but who are progressive and keep abreast of the times, who watch every trend and development in industry, begin wondering what the next year's cars will be like. To satisfy both these groups, we shall present in our January issue a survey of the automobile industry—as completely as possible in limited space—giving information as to new models and outstanding developments of a large number of the best known cars. Also a detailed article on the Cord front-drive car, another which explains what has been learned by engineers at the annual races at Indianapolis, an article full of human interest concerning the grueling tests on an automobile proving ground, and still another dealing with the gasoline research laboratories which are doing their utmost to help the motorist, will be included in the issue. Besides these, there will be many short items on independent developments and the usual variety of science articles.

Element 91—At Last

PROTACTINIUM—radioactive and possibly a future substitute for radium, rarer in ores but relatively plentiful in wastes from radium extraction plants, and with a life 20 times that of radium—has been studied in oxide form. An article ready for release gives some illuminating information on this metal.

Wire Webwork

ALMOST half enough wire to reach from the earth to the moon will go into the Hudson River Bridge cables. How that wire—which can sustain a weight of 7600 pounds—is spun into cables by means of "spinning" wheels which move back and forth across the river on a tramway cable like monster spiders or slow shuttles on a loom, will be told in a coming article.

Air

"CITIZENS in about half the United States are forced by law to live in air that is harmful." *Forced by law!* This statement from a forthcoming article seems rather rash but the author is an authority and cites facts to prove what he says. He continues with a discussion of air which disproves a number of old "scientific" theories regarding the air we breathe.

Every Issue Fully Illustrated

¶ *Men are known by the magazines they read. What easier road to distinction could there be than reading the* SCIENTIFIC AMERICAN*—at four dollars a year?*

Among Our Contributors

Lester D. Seymour

DURING the World War, Captain Seymour served as Aircraft Maintenance Officer of the 85th Aero Squadron in France. After the Armistice, he took a course in aeronautical engineering in the Ecole Superieure d'Aeronautique in Paris. Resigning his commission in 1919, he became consulting engineer in the office of the Chief of the Army Air Corps. He became affiliated with the N. A. T. shortly after its organization and since has held several positions and is now General Manager.

Horace H. F. Jayne

EDUCATED at Harvard, Mr. Jayne was a member of the first and second Chinese expeditions of Fogg Museum, Harvard College. Since 1923 he has been Curator of Oriental Art at the Pennsylvania Museum of Art. He has been Director of the Museum of the U. of P. since May, 1929.

Ida Treat

MISS Treat, an American born in Cleveland, was educated at Western Reserve University. Later she taught the Romance languages for some time. She went to the Sorbonne to take her doctorate in Romance languages and there married a French artist who was afterwards elected a deputy to parliament from Ariègè. They spent their summers at Foix, the caves of which were already known to Miss Treat's husband. In consequence of this, she became interested and began the study of physical anthropology and of osteology.

David Masters

ONE of the select few writers who can present his subject in a style at the same time lucid, technically correct, and possessive of a popular appeal, Mr. Masters is an English writer of several books which have been well received in England. One in particular, "The Wonders of Salvage," has been acclaimed the best on the subject. Having written this, Mr. Masters took a special interest in the job of salvaging the German fleet and has written interestingly of this huge undertaking and of his own visits to the scene of operations.

S • A • F • E

Features of Ford Plane

All-metal (corrugated aluminum alloys)—for strength, uniformity of material, durability, economy of maintenance, and structural safety.

Tri-motored (Wright or Pratt & Whitney air-cooled engines, totaling from 900 to 1275 horsepower) — reserve power for safety.

Speed range—55 to 135 m. p. h. Cruising radius, 580-650 miles.

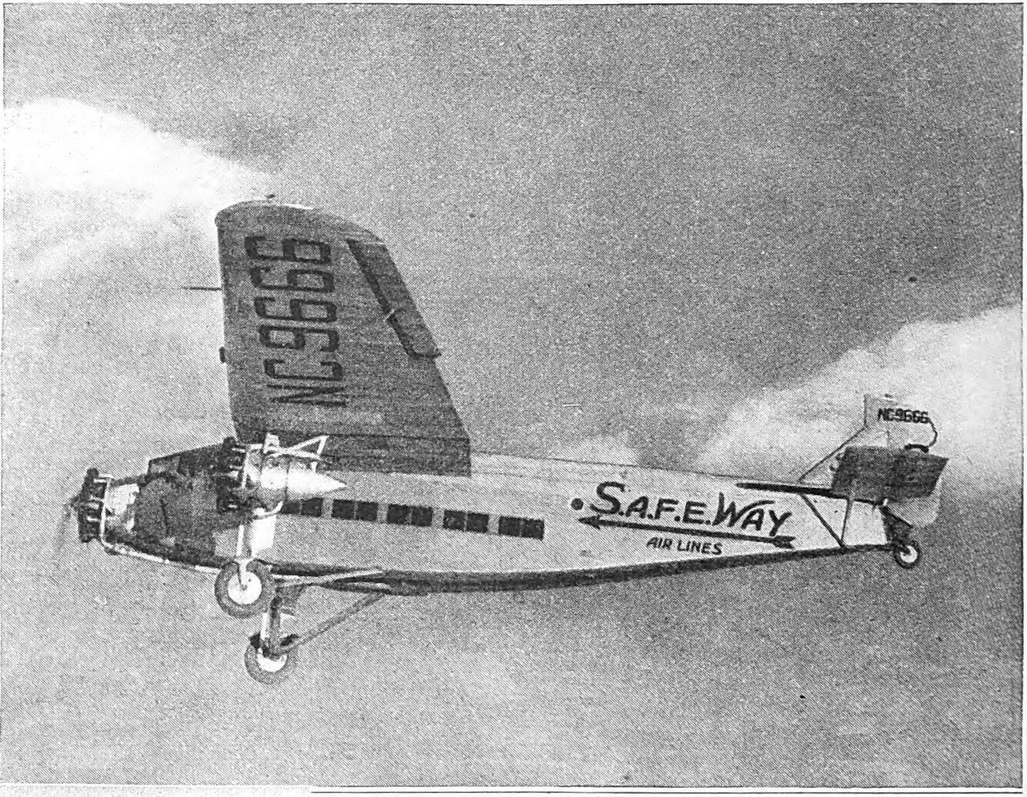
Disposable load—3670 to 5600 pounds.

High wing monoplane (single, stream-lined, cantilever wing) —for strength, speed, inherent stability, visibility, clean design. . . .

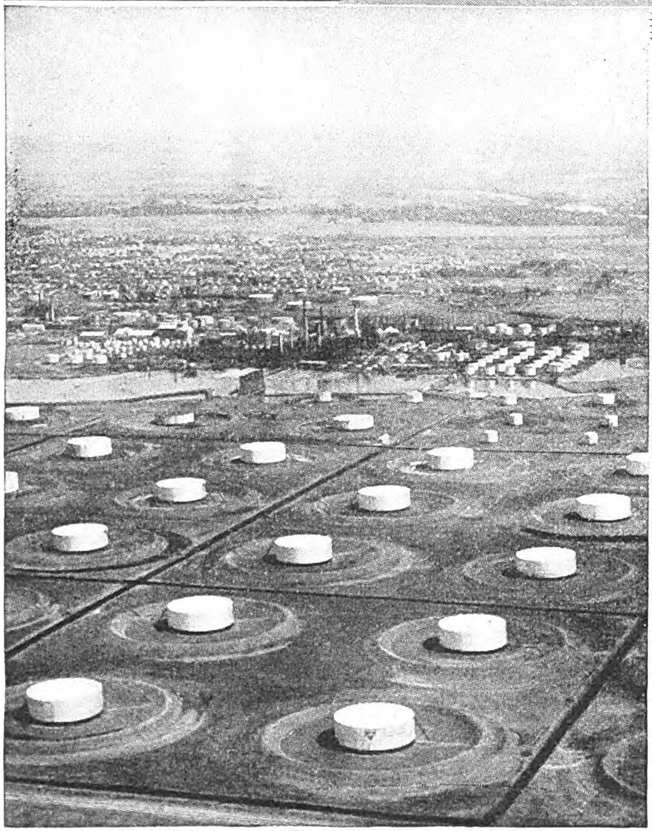
17 *capacity* (including pilot's dual-control cabin) — Buffet, toilet, running water, electric lights, etc.

Durability — Uniform all-metal construction is insurance against deterioration.

Price, $42,000 to $55,000 (standard equipped at Dearborn)— Exceptionally low because of multiple-unit on-line production methods.



Passenger transports should take no chances! . . . The S-A-F-E uses three-motored Fords to insure a wide margin of safety



With great distances to be traversed . . . scattered points of rich productiveness to be visited . . . the Southwest is ideal for air transportation

Southwest of St. Louis and Kansas City is a great region that probably expresses American modernism more accurately than any other. It is rich. It is decidedly virile. It is one of the most alert regions in the world. It is logical, therefore, that this region should be the scene of one of the most pronounced and successful developments of commercial transport aviation. . . .

Colonel Halliburton, who established the Southwest Air Fast Express, has already in operation a fleet of nine tri-motored, 14-passenger, all-metal Ford planes. The S-A-F-E is right up to the minute in every phase of modern transport. Company limousines and five special aerocars transport passengers direct to and from downtown districts and the transport planes. Scheduled connections are made with all important trains.

St. Louis . . . Springfield . . . Tulsa . . . Kansas City . . . Coffeyville . . . Oklahoma City . . . Fort Worth . . . Dallas . . . Wichita Falls . . . Sweetwater! All these are connected by schedules designed to work in conjunction with the railroads . . . *so that far distant sections of the country are brought within twenty-four hours' plane-train ride of each other.*

The safety factor, as much as anything else, determined Col. Halliburton in the choice of Ford tri-motored transports . . . since three engines provide the necessary margin of safety in carrying passengers. *From the inauguration of service on April 2nd, over 2500 miles have been flown daily.*

FORD MOTOR COMPANY

Visitors are always welcome at the Ford Airport

How to be *Generous* to a man at Christmas

JUST how does the Gillette Fifty Box qualify as the ideal Christmas gift for a man? Here's how—on these eight counts:

It is practical . . . Man, famous for his practical mind, insists on useful gifts.

Yet he probably wouldn't buy this for himself . . . From long habit, he is used to getting his blades in packs of five and ten. This will be a new and refreshing idea for him.

He'll be sure to use it . . . Blades are a daily necessity in every man's life. The Gillette Fifty Box is the most convenient way to have them.

It is personal . . . It's all to himself, for his own intimate, bathroom use.

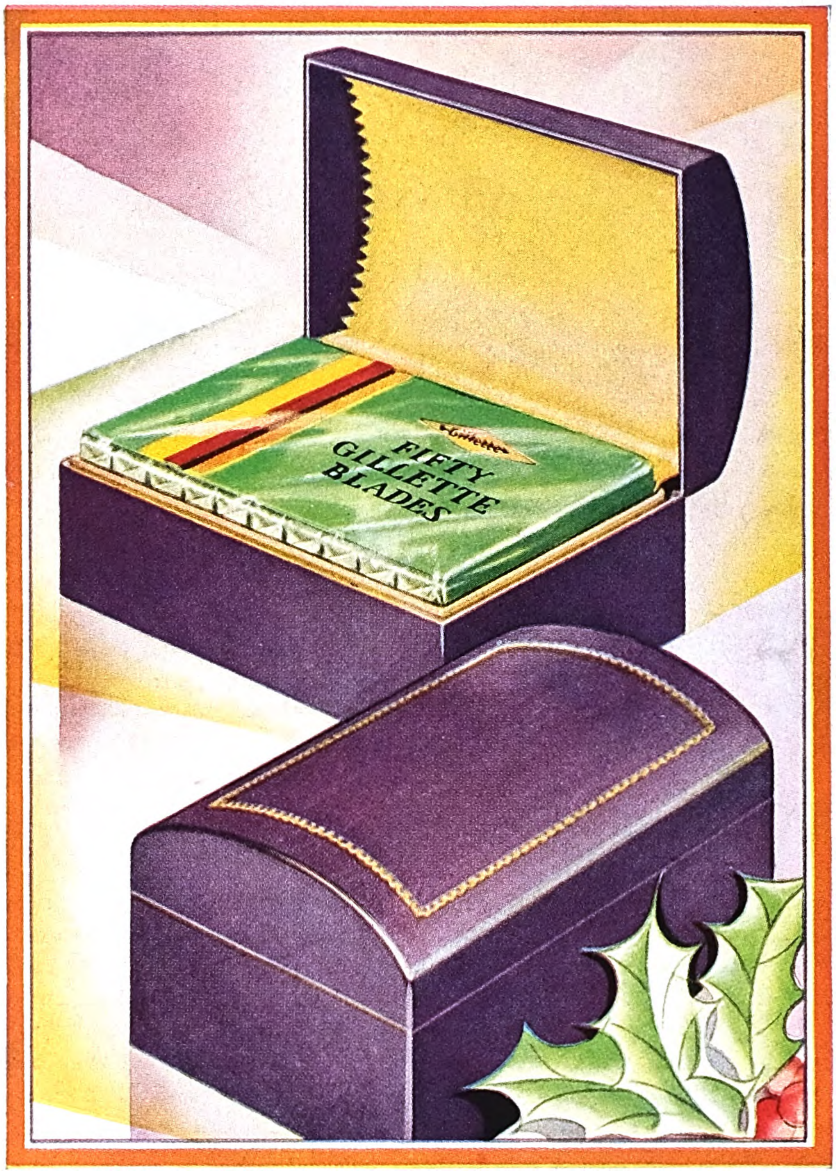
It is good looking . . . Packed, as you see in a metal box, velvet lined, with a spring-hinge cover. Blades are enclosed in brilliant Cellophane.

It is truly generous . . . With fifty smooth, double-edged Gillette Blades in easy grasp, a man can look forward to more continuous shaving comfort than he has probably ever enjoyed before in his life.

It will last well beyond the Christmas season . . . For months his mornings will be free from all thought of buying Gillette Blades.

It is reasonable in price . . . Five dollars buys this *ideal* gift. On sale everywhere.

GILLETTE SAFETY RAZOR CO., BOSTON, U. S. A.



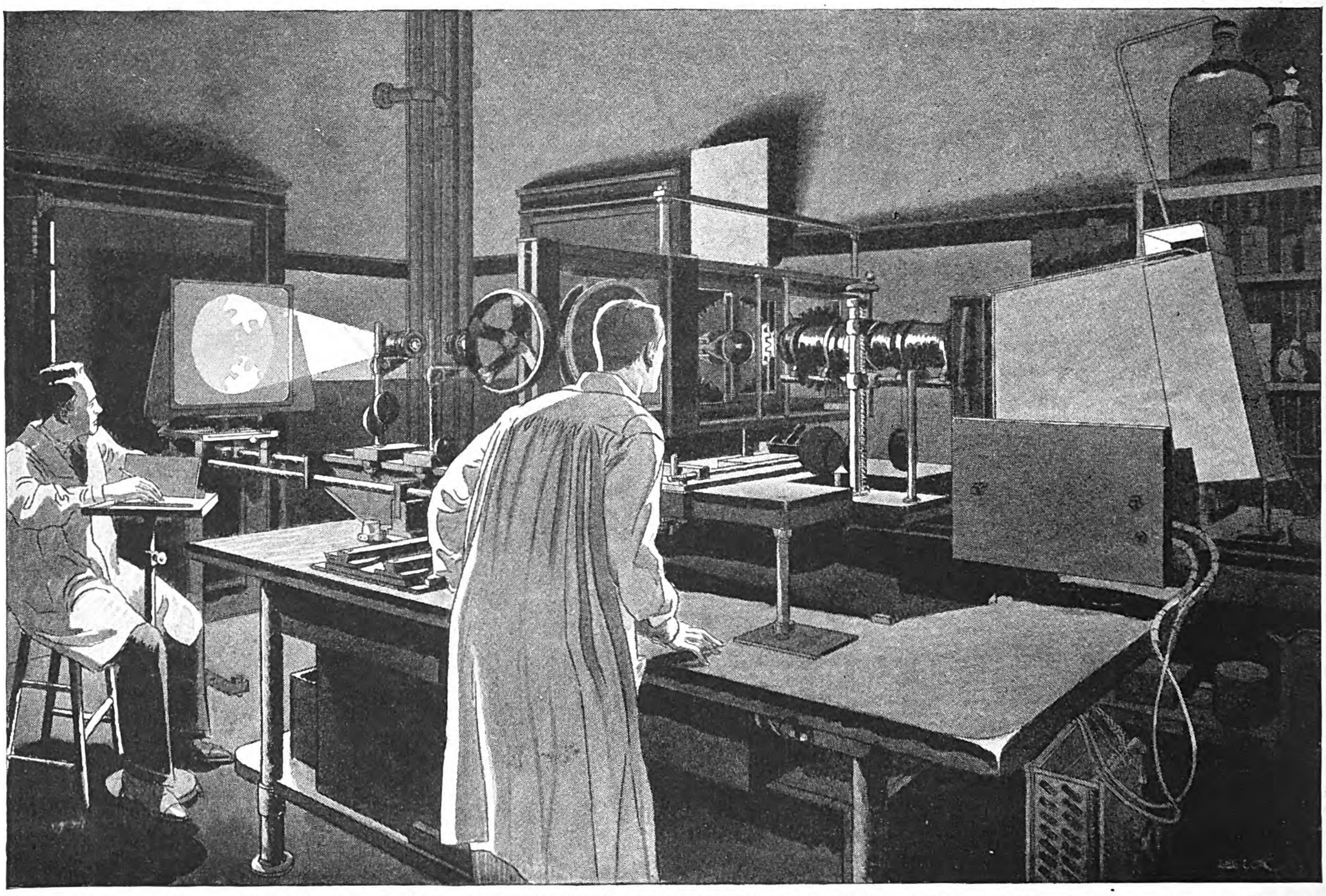
Gillette

Gillette

Five Dollars

GIVE HIM SHAVING COMFORT IN ABUNDANCE WITH THE FAMOUS FIFTY BOX OF GILLETTE BLADES

WHAT WESTINGHOUSE IS DOING IN RESEARCH



DRAWN FOR WESTINGHOUSE BY C. PETER HELCK

WESTINGHOUSE MEASURES INTERNAL STRESSES IN MACHINE PARTS WITH THIS LIGHT-PROJECTION MACHINE

Tomorrow's electrification--on view today

Spend today with Westinghouse research engineers and catch a glimpse of what Westinghouse is doing toward meeting tomorrow's electrical requirements . . .

In a quiet wing of the laboratories in East Pittsburgh, slightly pungent with the fumes of mysterious chemicals, specialists are applying electricity to chemistry. Time alone can tell what new electrical principles they will uncover to aid the industries that depend on chemistry for their advancement.

A cathode ray tube sputters in a dark corner. We know it as the greatest concentrator of energy man has yet developed. Nothing can live in the path of its rays. Westinghouse research is seeking its commercial value.

Here we find men working on new insulators for higher voltages, and new insulators with metallic glaze making it possible to solder cables securely to porcelain. There they are applying unusual tests to find the dynamic strength of metals, and the amount of permanent distortion they may undergo at high temperatures. Again they are developing inexpensive iron-base alloys to take the place of platinum in tubes and cells.

Now we are among the grid-glow tubes and photo-electric cells. These super-sensitive tubes are the keys to automatic traffic controls, fire and smoke detectors, counting and sorting devices that need not touch their subjects, and switches that will turn on lights automatically when daylight wanes. Thus Westinghouse research is ever looking forward, alert to the future needs and possibilities of every application of electricity—leading the way to new economies for industry and new conveniences and comforts for the home.

Westinghouse Electrification
Appliances Apparatus
Wiring
THIS SIGN YOUR GUARANTEE
W
WESTINGHOUSE ELECTRIC

The Sign of a Westinghouse Dealer

Westinghouse

The blooded camels of Arabia's merchant princes were swift and strong and luxuriously equipped

LUXURIOUS TRANSPORTATION

THE Packard Standard Eight Five-Passenger Sedan is but one of the eleven distinguished models now offered in the Standard Eight line. It embodies the beauty and luxury which the fine car buyer has learned to associate with the name Packard.

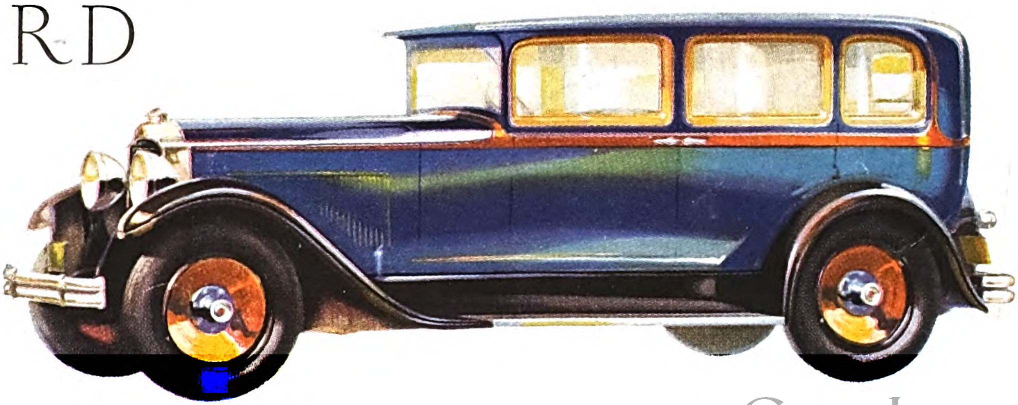
Built on the popular 126-inch wheelbase chassis, and newly refined and improved, it differs from the famous Custom and DeLuxe Eights only in size, power and the degree of individuality available in color, upholstery and appointments. The handsome and roomy bodies, like those of the Custom and DeLuxe models, are designed and produced entirely in the Packard factory.

The same excellence of engineering, the same expert craftsmanship, found in the larger and higher-priced Packards, produce the Standard Eight Sedan. In comfort, beauty and distinction, in ease of handling and brilliance of performance, this popular model is every inch a Packard—luxurious, smooth and fleet.

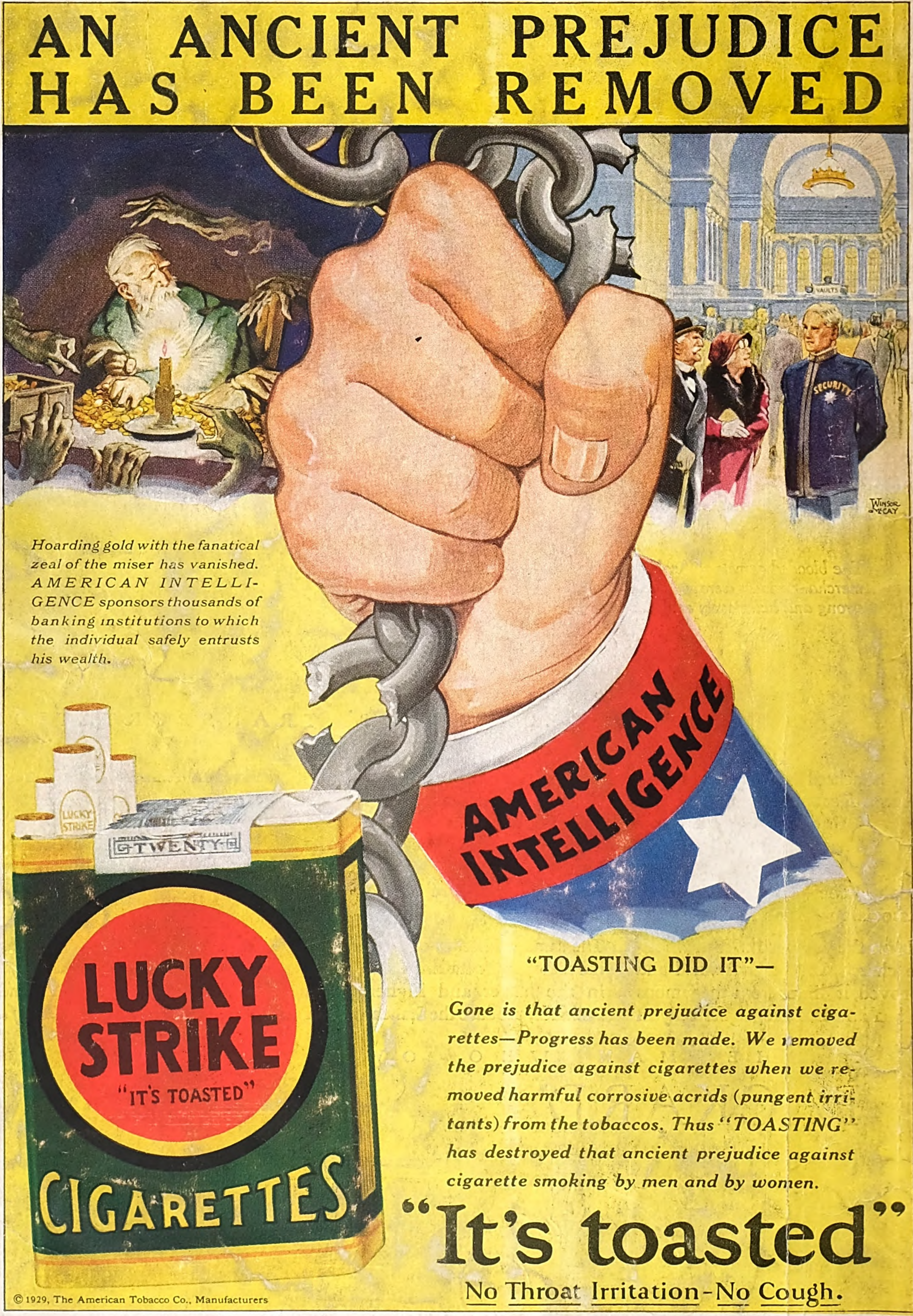
Since its introduction the Packard Standard Eight has been a conquest car—has won new thousands to Packard ownership. It is literally true that two out of every three Standard Eight buyers *give up other makes of cars.*

ASK THE MAN WHO OWNS ONE

PACKARD



PRINTED IN U. S. A., BY ART COLOR PRINTING COMPANY, DUNELLEN, N. J.


AMERICAN INTELLIGENCE
VAULTS
SECURITY
WINSOR MCCAY
LUCKY STRIKE
TWENTY
LUCKY STRIKE
"IT'S TOASTED"
CIGARETTES

AN ANCIENT PREJUDICE HAS BEEN REMOVED

Hoarding gold with the fanatical zeal of the miser has vanished. AMERICAN INTELLIGENCE sponsors thousands of banking institutions to which the individual safely entrusts his wealth.

"TOASTING DID IT"—

Gone is that ancient prejudice against cigarettes—Progress has been made. We removed the prejudice against cigarettes when we removed harmful corrosive acrids (pungent irritants) from the tobaccos. Thus "TOASTING" has destroyed that ancient prejudice against cigarette smoking by men and by women.

"It's toasted"

No Throat Irritation-No Cough.

© 1929, The American Tobacco Co., Manufacturers

UNIVERSITY OF ILLIN
3 0112 004